SIGNAL

12TH ANNUAL CONVENTION ISSUE

COMMUNICATIONS

ELECTRONICS

PHOTOGRAPHY

afcea

—DEVELOPMENT—

—TECHNOLOGY—

"THE TRINE OF PROGRESS"

—RESEARCH—

JUNE 4, 5, 6
1958

Sheraton-Park Hotel · Washington, D. C.

1948—*Early "point contact" transistor.*

The remarkable transistor observes its 10th birthday

In 1948, Bell Telephone Laboratories announced the invention of the transistor. In 1958, the transistor provided the radio voice for the first United States satellite.

To advance the transistor to its high level of usefulness, Bell Labs had solved problems which, in themselves, approached the invention of the transistor itself in scientific achievement.

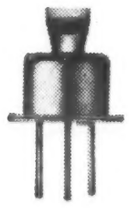
First, there had to be germanium of flawless structure and unprecedented purity. This was obtained by growing large single crystals—and creating the "zone refining" technique to purify them to one harmful part in *ten billion.*

The "junction" transistor, another radical advance, spurred transistor use. Easier to design, lower in noise, higher in gain and efficiency, it became the heart of the new electronics.

An ingenious technique for diffusing a microscopically thin layer on semiconductors was created. The resulting "diffused base" transistor, a versatile broadband amplifier, made possible the wide use of transistorized circuits in telephony, FM, TV, computers and missiles.

In telephony the transistor began its career in the Direct Distance Dialing system which sends called telephone numbers from one exchange to another.

For Bell System communications, the transistor has made possible advances which would have been impossible or impractical a brief decade ago.



1958—*Satellite transistor, incorporating 10 years of Bell System research and development.*

BELL TELEPHONE SYSTEM

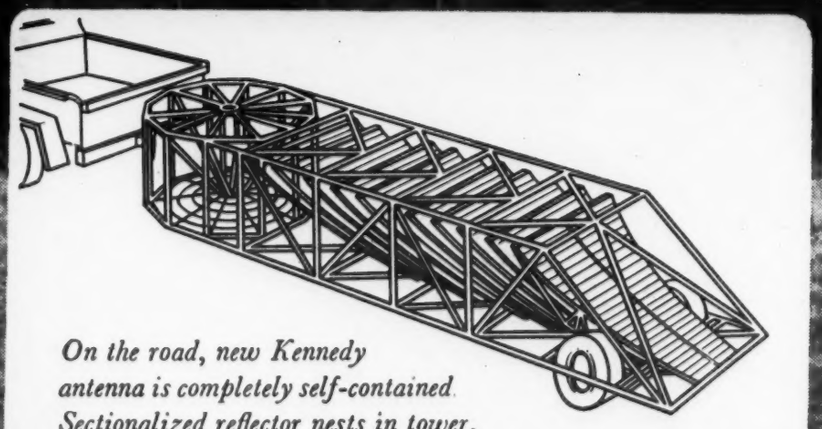
See and hear how the Bell System protects continuity of communications in time of disaster—Booths 34 to 36.

KENNEDY'S NEW *Site-Selector* ANTENNA

takes the guess work out of scatter system planning!

SOLVES PROBLEMS LIKE THESE
on the spot:

distance
diversity
antenna size
terrain effect
antenna gain-loss figure



On the road, new Kennedy antenna is completely self-contained. Sectionalized reflector nests in tower. Retractable wheels convert tower to trailer.

Now, a giant step forward in scatter system planning—a mobile, 28′ scatter antenna that can be towed to the site and quickly erected for actual on-the-spot testing *before* erection of the permanent installation!

Thus, expensive, time-consuming trial-and-error guesswork is eliminated. The *right* location is determined *before* installation, with an assurance never before possible. And shipping and handling costs are greatly reduced.

BE SURE TO SEE THE SITE-SELECTOR AT THE AFCEA SHOW.

ANTENNA EQUIPMENT

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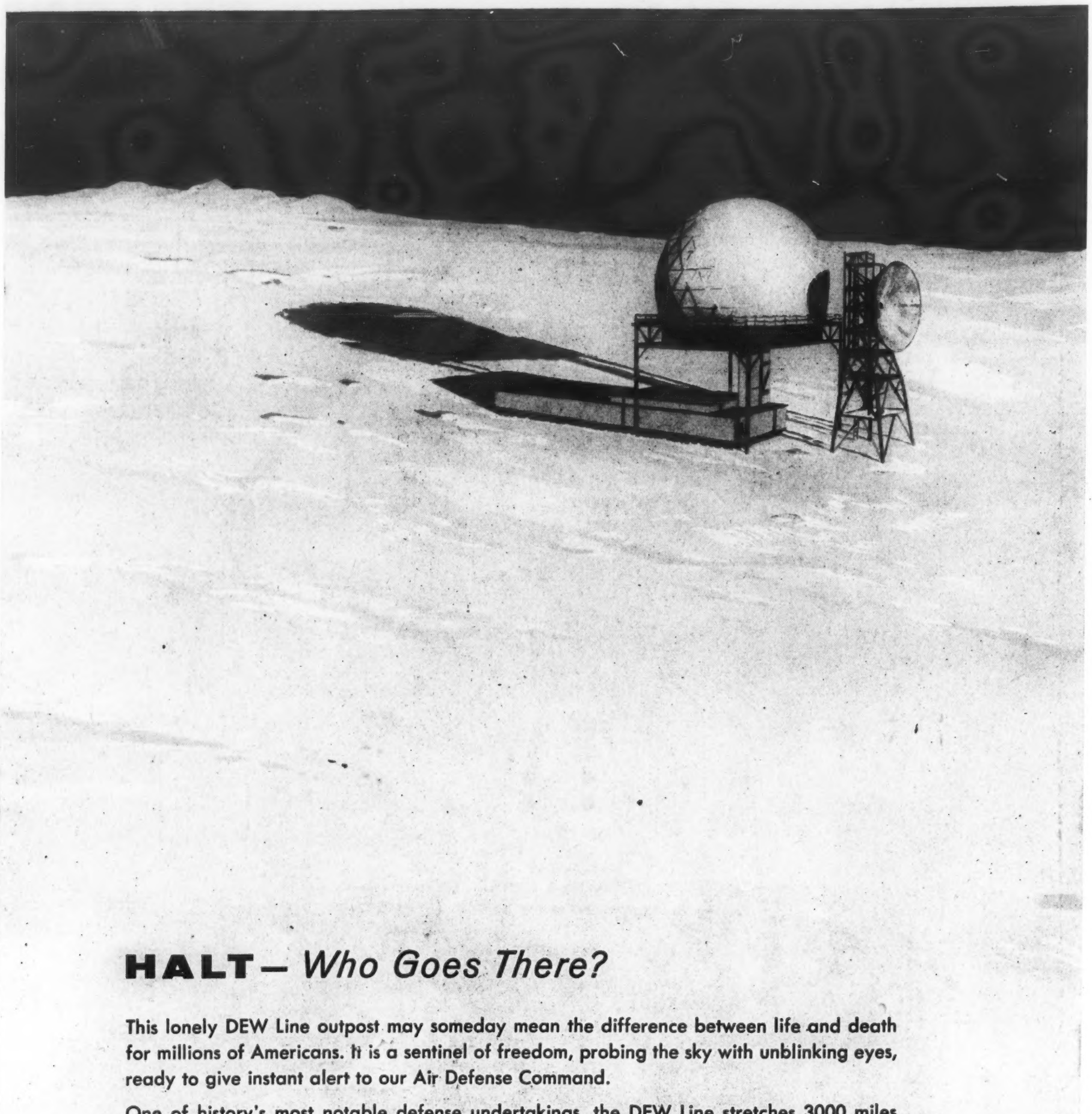
Tracking Antennas
Radio Telescopes
Radar Antennas
"Trans-Horizon" Antennas
Ionospheric Scatter
Tropospheric Scatter



HALT— *Who Goes There?*

This lonely DEW Line outpost may someday mean the difference between life and death for millions of Americans. It is a sentinel of freedom, probing the sky with unblinking eyes, ready to give instant alert to our Air Defense Command.

One of history's most notable defense undertakings, the DEW Line stretches 3000 miles across the frozen north. Each radar site is linked with others in the chain through Lenkurt single-sideband carrier equipment which "channelizes" voice, data and intercept command signals for radio transmission.

As a leading specialist in telecommunications, Lenkurt is being called upon to supply key equipment for an increasing number of vital defense installations. Lenkurt's facilities are uniquely oriented to providing research, development and precision production to meet the high standards and exacting needs of government and military projects.

Lenkurt
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BPA

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XII JUNE 1958 NUMBER 10

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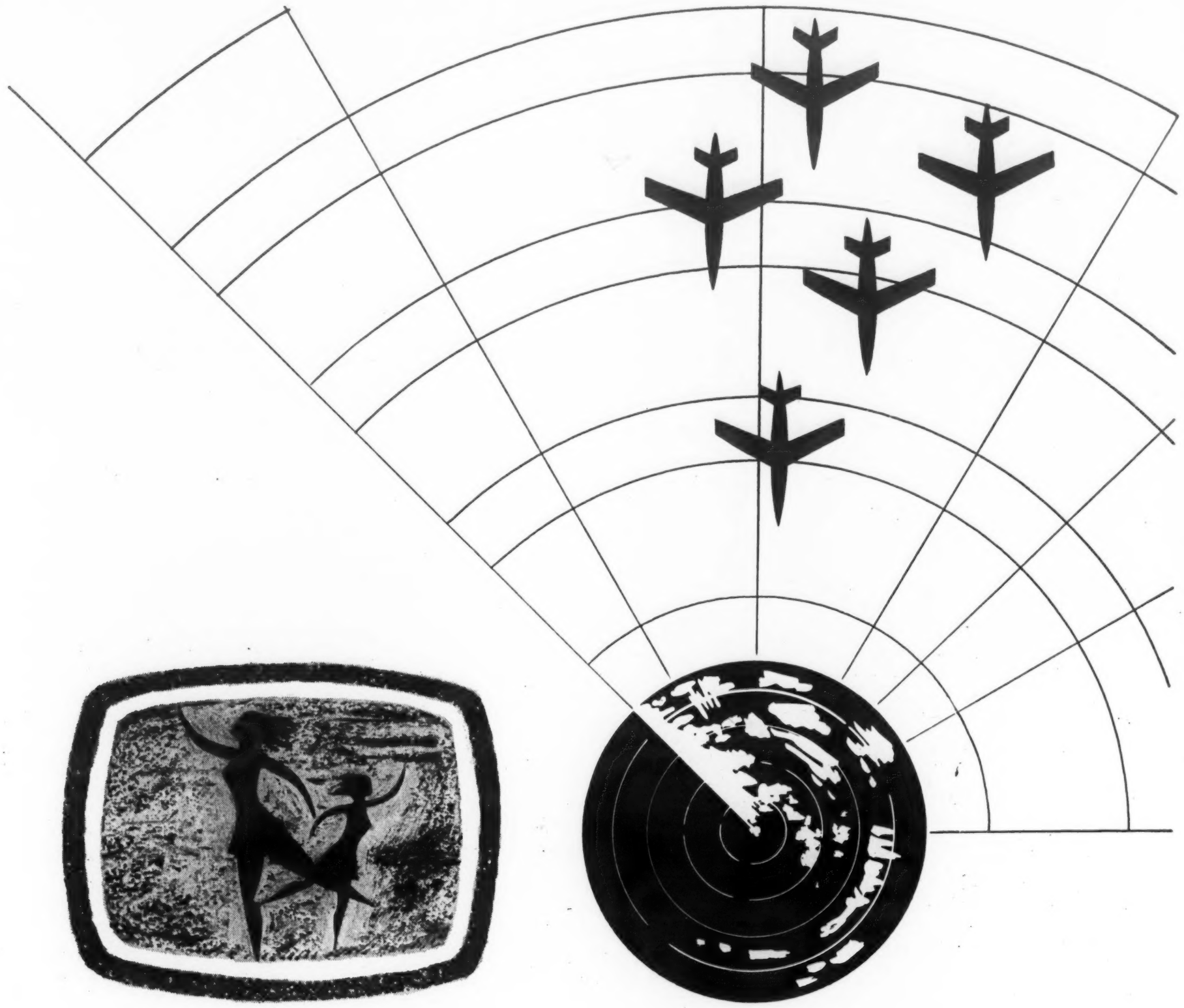

a sense of proportion

A component fails in a TV set and we lose a few hours of entertainment. Let the same component fail behind a radar screen . . . or in a missile . . . and we may lose the future. We will pay for high reliability whether we achieve it or not.

In cash if we do . . . in lives if we do not.

That's why Sprague **high reliability** components are specified in military electronics.

Write for Engineering Bulletin 2900 and Specification PV-100. Sprague Electric Company, 287 Marshall St., North Adams, Mass.

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PRESIDENT FREDERICK R. FURTH

Rear Admiral, USN (Ret.)
Vice President, IT&T Corp.
NATIONAL PRESIDENT, AFCEA

A Convention Welcome

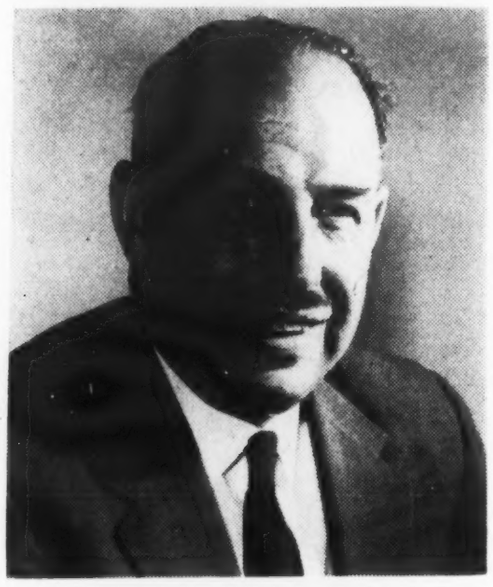
For the second successive year, Washington, D. C., is the scene of the Armed Forces Communications and Electronics Association's Convention, and, as in the past, it will be attended by a distinguished group representing industry and the military services from all parts of the country. The members of the Association and friends will view the skillfully arranged exhibits, hear the presentation of carefully chosen professional papers, listen to outstanding speakers and have the opportunity to relax and enjoy the social events. As President of AFCEA, I wish to take this opportunity to extend a most hearty and cordial welcome to all who are attending the 12th AFCEA Convention and my personal greetings to those who, because of previous commitments, cannot be with us.

Our Convention theme, "Research, Development, Technology—the Trine of Progress," is truly meaningful and has the ring of confidence and optimism. I say this sincerely for it relates to the progressive ideals and the educational and patriotic objectives of our Association. To meet the challenge of this atomic and space age, AFCEA has the opportunity through its members, group members, and chapter organizations to make a contribution which will strengthen our national security, improve our standard of living and guarantee the peace which all individuals desire.

At the end of my term of office as President of your Association, I wish to thank every member for the support I have received. I am particularly indebted to the officers, Executive Committee, the Board of Directors, the chapter officers, and the personnel of National Headquarters.

Convention Speakers

★ ★ ★ ★



J. Lewis Powell
Office of the Assistant Secretary of Defense (S&L)

KEYNOTE LUNCHEON SPEAKER

To be introduced by Charles F. Horne, Convair

During WW II, Mr. Powell served with the War Production Board and later as a naval officer in the Executive Office of the Secretary of the Navy. In both assignments he worked in the field of industrial mobilization on a nation-wide basis. In his present position, his principal responsibility involves all military programs in industrial mobilization planning for the production of military items in event of war.

Mr. Powell, a graduate mechanical and aeronautical engineer, will speak on the subject of "The Collapse of Time," as the principal ingredient in the field of technological progress.

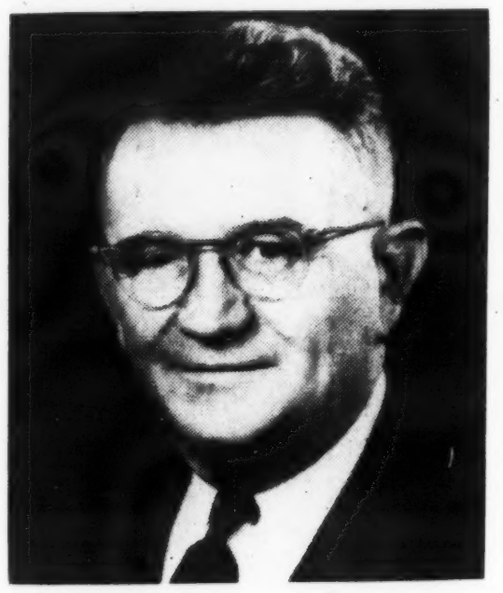
★ ★ ★ ★

BANQUET SPEAKER

To be introduced by James M. Bridges, DOD

Never too proud to do anything to increase his knowledge and usefulness and make a contribution to society, General Hershey has literally been the symbol of the true American boy. Reaching the pinnacle of success through sheer desire and will, he has never forgotten his fellow men as he climbed the ladder of success from farm boy to educator, military general and director of one of the most important agencies of our Government. For his outstanding accomplishments, he has received Presidential recognition. He has been honored by educators, civilian and fraternal organizations and has been awarded several of the nation's highest military decorations.

Never idle, General Hershey combined farm work with his early education in a one-room country schoolhouse. Alternately, he worked as a farmer and county sheriff as he earned his college education. His degrees include a BA, BS & LLB. In the military, he made his goal the hard way—from private to general. Serving the nation in his present position of great responsibility, he is respected by all branches of the government and, more importantly, by his employees and the American citizens he so ably serves. As a rare combination of educator, statesman, humanitarian, civil and military leader—truly he is the Will Rogers of today.



General Lewis B. Hershey
Director of Selective Service

★ ★ ★ ★

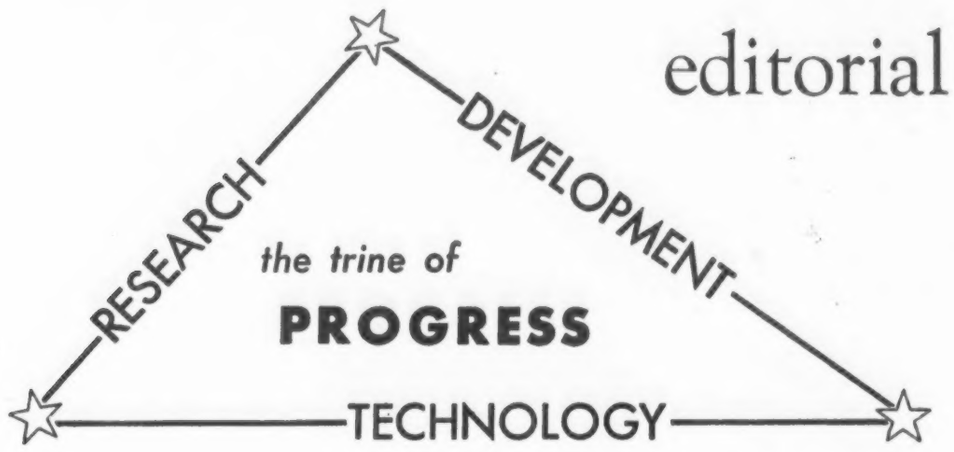
James D. McLean
Pres., Hoffman Laboratories

INDUSTRIAL LUNCHEON SPEAKER

To be introduced by Percy G. Black, General Tel.

One of the youngest executives in the electronics industry, James D. McLean, President of Hoffman Laboratories, will speak on the subject of solar energy and its potential applications in providing power for military and commercial uses. Particular stress will be placed on the development of solar power supplies for space vehicles. Under Mr. McLean's leadership and direction, Hoffman Laboratories, pioneering in a new field, have become the exponents of the new "Team Concept" approach in government contracting for weapons systems. Mr. McLean is a graduate of MIT and has received his BS and MS degrees in Electrical Engineering. He was associated for nine years with the General Electric Company and was former Vice President and General Manager of the Government and Industrial Division of Philco before joining Hoffman Laboratories.

W. J. BAIRD
EDITOR



editorial

NEVER before in the history of nations has the theme of AFCEA's Convention, "Research. Development and Technology —The Trine of Progress," meant so much to national stability and future security. It has become fundamentally essential that peace loving individuals pool this scientific knowledge in enterprise systems which will produce goods and services for the betterment of all mankind. What the world needs more today is not a suppression of facts but a comprehensive understanding of the interdependence of national economic strength with national power. Obstructions and hazards which have plagued undeveloped countries in the past must be removed by the combined research. development and technological know-how of those nations whose human, material. and economic resources are capable of making a significant contribution to the advancement of civilization. In these troubled times, serious thought must be given to the grave and unprecedented national and international problems to insure peace and security without sacrificing our heritage of freedom and our concept of the dignity and the rights of the individual. The problems of the past decade compel something more than a new look at old plans and policies. They require a modification and thorough revision of basic assumptions upon which past planning has been based.

Just as our fundamental shift to world leadership required a sweeping change in our national outlook, so have we come to realize the importance of facing up to the challenge which confronts us in this changing age. This realization has forced upon us the inevitable conclusion that we as individuals can no longer afford the luxury of complete preoccupation with our own affairs to the exclusion of national affairs.

It is ironical how often our present position of world leadership is characterized by the platitudenous statement that we live in an age of social, economic and industrial revolution. World tension has been sweeping the Universe like a satellite. It has caused a form of frustrated hysteria and tension which in the minds of many may be eating into our way of life like a consuming flame. It is not always easy to come up with the right answers relating to world peace which we as citizens not only expect but at times demand. A look at the record reveals that inconsistencies are inherent in the reasoning powers of individuals. Many of our international problems stem from our position of world leadership and come to us through Providence rather than desire. Some of these problems may be considered as having been unconsciously self-inflicted, but more truly they have been born as a result of a misunderstanding of the principles and motives of American democracy by those we desire to help so much. Following WW II, many European nations who found themselves on the brink of disaster managed to regain their prestige and economic stability not so much through their own internal management but more precisely by the timely and voluntary intervention of American generosity and assistance. But even though we provided a major economic lift, our intentions were all too often viewed with skepticism, and in many instances created deep-seated and lasting resentment. One does not have to look far or search deeply to find the answer to this attitude. Inevitably, any give-away program without strings conjures up the idea of "What do you expect in return?" Agitate this thought by a series of strategically planned Soviet propaganda moves and our apparent failure to cash in on our goodly intentions becomes understandable.

Whether we like it or not, these United States of ours cannot avoid the responsibilities which our leadership entails. The actions we take in purely domestic affairs have worldwide significance and repercussions. I mention this corollary merely because at times we are apt to forget that it is necessary to judge the course of action we take in domestic matters, not only against domestic conditions, but also against its effect on world opinion. If we do not measure up to our responsibilities, all that mankind has gained in individual status since the Dark Ages will be irretrievably lost.

Blessed with the democratic form of government that we enjoy, it is not only desirable and appropriate but quite natural for us to live in peace and amity with all other nations of the earth. But as a fundamental aspect of "peaceful co-existence" we envisage a normal flow of free communications between nations. And a normal flow of free communications between nations is precisely what the leaders in the Kremlin do not dare permit.

The reason for this is rather simple. There is something basic in the natural urge of human beings for freedom. We see it in the frequent expression of will on the part of our growing children. As long as freedom and the concept of dignity of the individual exist, anywhere in the world, and the people of the Iron Curtain countries are aware of that fact, they must necessarily long to throw off their yokes and themselves be free men.

When we consider that Charleston, South Carolina, and Boston, Massachusetts, from a communications standpoint, are closer today to Moscow and Peiping than they were to each other in 1860, we realize that what Abraham Lincoln applied to a nation alone is equally true of the whole world—it cannot forever exist half slave and half free. Sooner or later our concept of the individual must prevail — governments everywhere must become the servants of the people or people everywhere must become the slaves of the state.

As much as we deplore the actions of the Soviet Union, we cannot again make the serious error of regarding the Soviets as being stupid. We have

AFCEA NATIONAL CONVENTION PROGRAM

- 85 Exhibitors
- 110 Exhibit Units
- Daily Technical Sessions

- Trip to Andrews Air Force Base
- 6 Important Social Events
- Special Program for Ladies

PROGRAM OF EVENTS

Wednesday, June 4th

9:00 AM—**Chapter Presidents Conference**
Caribar Room

10:00 AM-
12 Noon—**Professional Papers**
Continental Room

12:30 PM—**Keynote Luncheon**
Speaker: J. Lewis Powell
Office of the Assistant Secretary of Defense (S&L)
Sheraton Hall

2:00 PM—**Panel Discussion—The Future of Self-Contained and Ground Controlled Navigational Aids**
Moderator: Captain Paul Goldsborough, USNR., Staff Director for Communications, Office of Sec. of Defense (S&L)
Sheraton Hall

2:00 PM—**Chapter Presidents Conference (Cont.)**
Caribar Room

6:30 PM—**Reception**
Continental Room

7:45 PM—**Buffet Supper**
Sheraton Hall

Exhibits: 11:00 AM—7:00 PM

Thursday, June 5th

9:00 AM—**Council & Directors Meeting**
Caribar Room

10:00 AM-
12 Noon—**Professional Papers**
Continental Room

11:30A.M.—**Bus leaves for Tour with Luncheon at Andrews Air Force Base**

6:30 PM—**Reception**
Continental Room

7:45 PM—**Banquet**
Speaker: Lt. Gen. Lewis B. Hershey, Director of Selective Service
Sheraton Hall

Exhibits: 11:00 AM—7:00 PM

Friday, June 6th

10:00 AM-
12 Noon—**Professional Papers**
Continental Room

12:30 PM—**Industrial Luncheon**
Speaker: James D. McLean
President, Hoffman Laboratories
Sheraton Hall

2:00 PM—**Panel Discussion — Futuristic Military Communications System**
Moderator: Colonel George P. Sampson, USA
Sheraton Hall

2:00 PM—**Student Activities**
(Details to be announced)

Exhibits: 11:00 AM—5:00 PM

FOR THE LADIES

Wednesday, June 4th

9:30 AM—Assemble in the Madison Room for a Continental breakfast, "get acquainted hour" and review of plans.

1:30 PM—Assemble in the Madison Room

2:30 PM—Bus leaves for specially conducted tour of the FBI.

6:30 PM—RECEPTION and BUFFET SUPPER
Sheraton Hall

Thursday, June 5th

9:00 AM—Assemble in the Madison Room

9:30 AM—Bus leaves for tour of the White House and the Wax Museum.

Mrs. Dorothy Christopher
Chairman, Ladies Activities

1:00 PM—Luncheon and Fashion Show—$3.00. Featuring the latest styles in women's hats. The Commentator will be Inga, Washington TV personality. Door prizes will be awarded.

OR

A tour of Andrews Air Force Base leaving at 11:30 AM. Transportation and lunch—$3.00.

6:30 PM—RECEPTION and BANQUET
Sheraton Hall

Friday, June 6th

9:00 AM—Assemble in the Madison Room

9:30 AM—Bus leaves for tour of the Bureau of Engraving and Printing and the Smithsonian Institution.

FOR LISTING OF EXHIBITS SEE PAGE 14

Captain Paul Goldsborough, USNR
Staff Director for Communications, Office of Sec. of Defense (S&L)

PANEL MODERATOR

THE FUTURE OF SELF-CONTAINED AND

GROUND CONTROL NAVIGATIONAL AIDS

★ ★ ★ ★

Colonel George P. Sampson, USA
Chief of Army Communications Service Division, OCSigC.

PANEL MODERATOR

FUTURISTIC MILITARY

COMMUNICATIONS SYSTEMS

★ ★ ★ ★

Professional Papers:

Wednesday, June 4th

10:00-10:30

"Facsimile Recording Using Magnetic Tape," by J. Wade Dorsett, Ampex Corporation

SYNOPSIS: This paper describes the general process of transmitting graphical data such as maps, photographs, etc., by means of facsimile and a system for recording and reproducing this material on magnetic tape. The discussion is centered about the Ampex developed "Faxtape" system. The complete process is described, beginning with the generation of the electrical signal in the facsimile transmitter. The signal path is traced through the various component parts of the Faxtape system and a functional description of the individual units is given. A detailed study of the parameters affecting picture quality, such as jitter and skew, is made. Results of operational tests performed on the system are described. Applications of the system are described and modifications possible for specialized usage discussed.

10:30-11:00

"Large Communication Networks for the Military Services and Other Government Agencies," by L. S. Whitby, Bell Telephone Company of Pennsylvania

SYNOPSIS: Mr. Whitby discusses the possibility of providing the Military Services with individual line standard telephone and telegraph services from the local telephone company. The larger networks, however, present problems of design and administration. It has been found necessary to establish large telephone offices near the headquarters of each major military command to give the military an office where they can place orders which will be so engineered that the many components will function when integrated into large networks.

11:00-11:30

"Communications Media for Space Age Systems," by Joseph L. Ryerson, Rome Air Development Center, Griffiss AFB

SYNOPSIS: The extensive development of radio communications has overcrowded the existing facilities. This paper proposes a solution to relieve this condition through the use of phenomena other than conventional radio frequencies for communications. Furthermore, Mr. Ryerson discusses communication through natural ducts by the use of low frequency radio, sound, light, heat and gamma rays. Estimates are made of the probable speed rates with which information may be transmitted by use of the cited phenomena. These areas of research offer extraordinary possibilities for solving the most severe problems which face the Air Force in its global mission today.

11:30-12:00

"Communications in the Arctic," by J. Krcek, Office of Naval Research, Navy Department

SYNOPSIS: Many of the Navy's operations have moved northward into the fringes of the Arctic. New problems in communications are posed by this and by the introduction of new weapons, greatly accentuating the need for improved reliability, capacity and speed of communications. The requirements for the Navy's operations are discussed and a broad, forward-looking program for solving the new problems is described. What makes this presentation of timely importance is that consideration is given to the fact that modern weapons have unprecedented capability. To take advantage of this capability, command and control of these weapons place very new demands on the communications linkages in the system.

Thursday, June 5th

10:00-10:30

"Military Photography," by Carl Orlando, U. S. Army Signal Research and Development Laboratories

SYNOPSIS: Mr. Orlando will present a discussion on the techniques for obtaining photographs from Army airplanes as well as drones. Moonlight photography, in-flight processing, in-flight photo transmission and photography in radioactive atmosphere will also be described. Several problem areas such as the optimum photographic system, instantaneous processing and automatic interpretation of photographs will be discussed. The new concept of warfare makes attention to these problems vital.

10:30-11:00

"Weather Radar, A Tool for Combat," by D. Swingle, U. S. Army Signal Research and Development Laboratories

SYNOPSIS: The origin, theoretical foundations, development, state of the art and future outlook for weather radar as a tool for the support of combat operations are considered in this article. A further discussion emphasizes applications of this powerful tool for combat area surveillance on the atomic battlefield which are considered in terms of atomic location, small-scale meteorological analysis and prediction and mobility.

11:00-11:30

"Applications of Digital Information Processing Systems in the Future Field Army," by M. Blitz, C. Dixon and H. Young, Sylvania Electric Products Inc.

SYNOPSIS: The volume of information handled by field armies in the past has often exceeded the capabilities of manual processing systems. In the next decade, increased requirements for mobility, flexibility, dispersion, shorter response time and the need to depopulate the battlefield of noncombat personnel make the adoption of an automatic data processing system highly desirable. While it is an obvious special requirement that data processing equipment designed for this application be rugged, it is also necessary that a thorough study of the information requirements of a future field army be made. Based on one particular postulated field army, this paper describes a number of possible automatic data processing systems for logistics, intelligence and personnel data handling, evaluating these in terms of such parameters as cost, mobility, security, vulnerability, reliability and capability.

11:30-12:00

"An Automatic Communications Switching System," by R. E. Montijo, Radio Corporation of America

SYNOPSIS: This paper describes a system of electronic equipment designed to collect and distribute the large masses of communications information required as input and output by electronic data processing centers. Featuring flexibility and the facilities for expansion, this system performs automatic transceiving, categorizing, routing, switching, and editing of digital communications data for a range of applications and traffic loads. This system is designed to be compatible with communication equipments utilizing common carrier facilities. It will operate with the data organization required by teletype, punched card, and ultra-high-speed magnetic tape transceiving equipment when available. This system of equipments is applicable to very modest communication loads, as well as large traffic rates. Through the use of solid-state techniques and component de-rating, the highest degree of reliability in commercial equipment is said to be achieved.

Friday, June 6th

10:00-10:30

"Channelizing Frequency Modulated Scatter Communication Systems," by Thomas A. Combellick, Lenkurt Electric Company

SYNOPSIS: Channelizing an FM scatter system is unique in many respects. This paper discusses the special problems involved due to the nature of the radio equipment and transmission media. Problems discussed include radio loading, noise reduction, signaling, regulation and standby equipment. Points are brought out in the discussion to support the conclusion that channelizing of equipment for scatter systems should have features not ordinarily found in wire-line or conventional line-of-sight systems.

10:30-11:00

"The Modern Air Force, Its Challenge to Communications and Electronics Research and Development," by Col. Gordon T. Gould, USAF, Air Force Research and Development Command, Andrews Air Force Base

SYNOPSIS: The science of modern war and its requirement for more complex weapons, in turn, dictates the requirement for automation and vastly superior electronic facilities. Current and future weapon systems are dependent upon integrated networks of electronic equipments which in some cases cover global expanses of geography. A fundamental aspect of these systems is the collection, transmission and processing of large amounts of data. Whether part of closed-loop weapon control system, for command control and decision making, or for varied types of operational support, a systems approach has become as essential as in the case of the weapon system. Col. Gould discusses requirements and aspects of the application of system management and engineering.

11:00-11:30

"The Product Review Program and the Need for It," by William J. Laverick, U. S. Army Signal Research & Development Labs.

SYNOPSIS: Mr. Laverick's discussion stresses the need for a Product Review Program of new equipments, as they are developed. The number of unsatisfactory equipment reports that arose out of the Korean conflict has shown the undeniable necessity of a re-examination of the cycle of development and production. Outlining the method of accomplishing this within the Signal Corps, Mr. Laverick expresses hope for an increased awareness on the part of both Signal Corps and industry development engineers of such absolute requirements as simplification, use of standard available components, reliability, maintainability, logistics considerations and producibility.

11:30-12:00

"Value Engineering," by Albert Sikorsky. Bureau of Ships, Navy Department

SYNOPSIS: A new management-engineering concept adapted from the General Electric Company's Value Analysis Program is being impressively put to use by the Bureau of Ships, Navy Department, to combat the rising cost of its ships and equipment. Called Value Engineering, it is one of the Bureau's most effective means to help prevent the Navy from being priced out of proper defense build-up. A truly practical approach to the problem of high cost and over-complexity, it is rapidly being put to use, voluntarily, by many contractors. In this paper Mr. Sikorsky discusses the Value Engineering Program in action.

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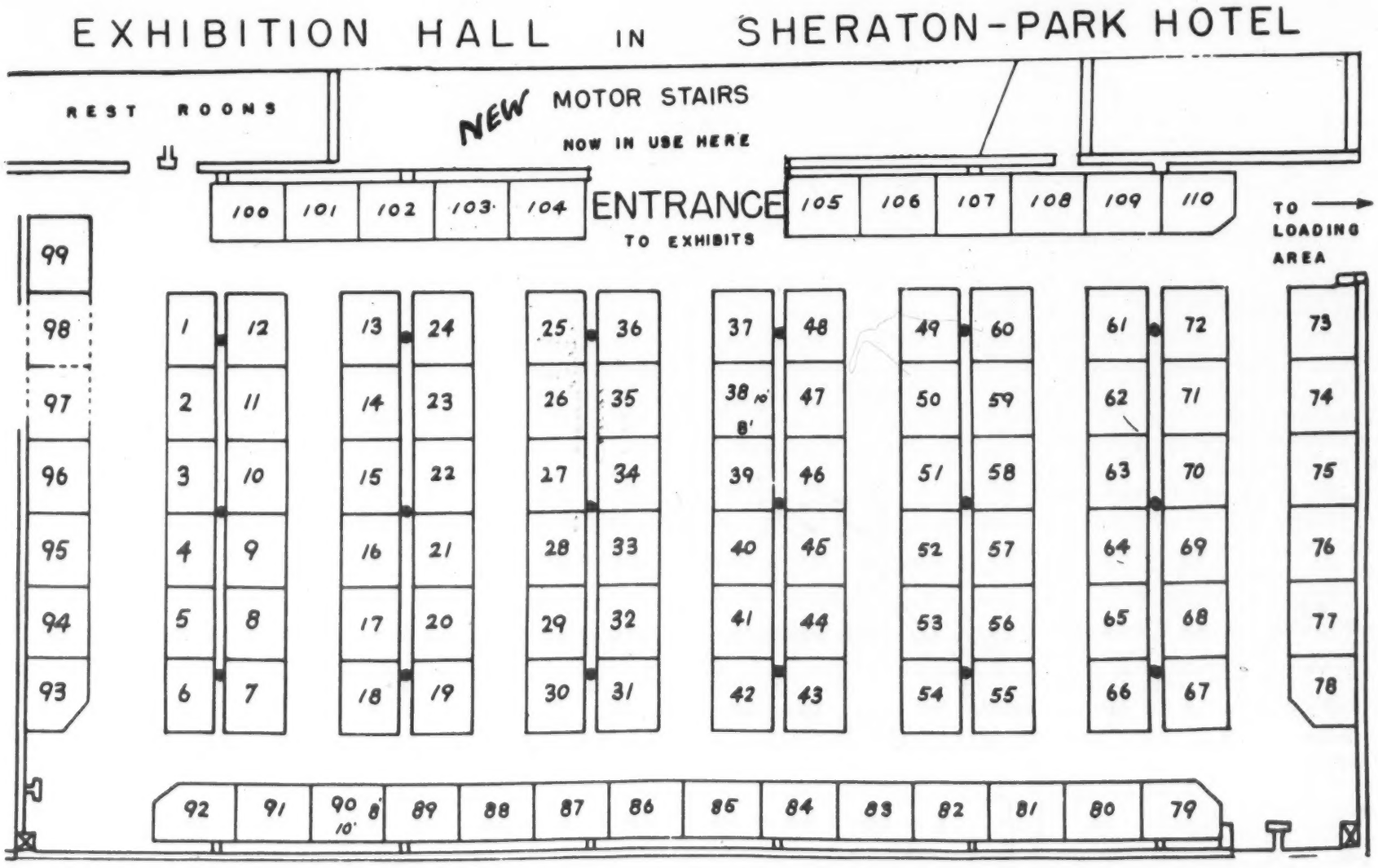

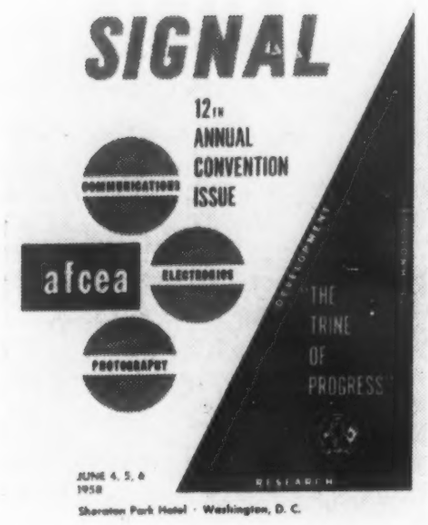

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72 West 45th St., New York 36, N. Y. • Murray Hill 2-6606

American Telephone & Telegraph Co. ***Booths #34, 35, 36***

32 Ave. of the Americas, N. Y. 13, N. Y.

• G. D. Montgomery, J. A. Osterman

See and hear how the Bell System protects continuity of communication in times of disaster.

Bell Telephone System Display

► See ad on 2nd Cover ◄

Applied Research Inc. ***Booth #72***

76 So. Bayles Ave., Port Washington, N. Y.

• A. M. Scandurra, M. Dolin, N. Poulos, C. Costas

An operating Broadband Multichannel Receiving System dividing the 350-550 mcs spectrum into 4 channels will be displayed; also Multiplexers, R. F. Amplifiers, Filters, Coaxial Attenuators and Terminations.

A.R.F. Products, Inc. ***Booth #1***

7627 Lake St., River Forest, Ill.

• R. J. Napolitan

Research and manufacturing facilities: AR-1B Deviation Meter; AN/UPM-15 Pulse Generator; Pulse Type Transmitter and Receiver for Remote Control; URM-48 FM Signal Generator; ARN-18 Glide Slope Receiver; Dummy Load for Testing Radar; Fabricated Components, such as Transit Cases, Dust Covers, Chassis, etc.

Assembly Products, Inc. ***Booth #14***

Wilson Mills Rd., Chesterland, Ohio

Meter-relays, temperature controls, voltage and circuit controls, and indicating panel meters—New Model 561.

► See ad on page 83 ◄

Automatic Electric Sales Corp. ***Booth #61***

Northlake, Ill.

• E. E. McCorkle, F. E. James, J. P. Costello, H. B. Bittner, L. B. Mitchell

Relays and Switches, for military and industrial applications; P-A-X Business Telephone Systems for private, automatic (dial-operated) intercommunications.

► See ad on page 37 ◄

Automatic Telephone & Electric Co., Ltd. ***Booth #59***

Strowger House, Arundel St., London, W.C.2

• H. R. A. Wood, W. H. Carsbury, M. M. Bain

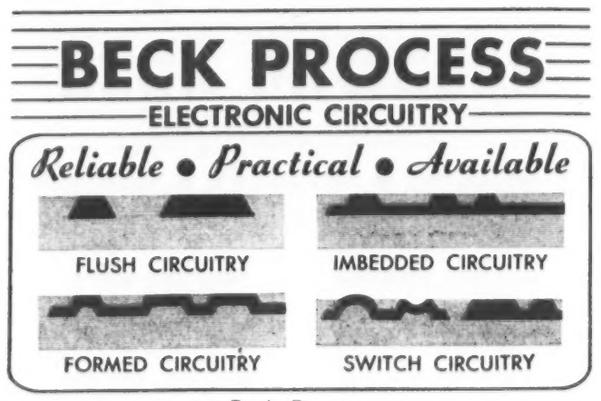
The A. T. & E. exhibit features VHF radio-telephone links type RL. This equipment can be integrated into telephone networks without changing existing operating procedures.

Beck's, Inc. ***Booth #30***

298-300 E. Fifth St., St. Paul 1, Minn.

• J. T. Beck, D. J. McKilligan

"Beck Process" printed circuitry is actually imbedded in the laminate—it's insulated; also flush type; reliable, practical, available; patented in U.S.A. and foreign countries.



Beck Process

► See ad on page 26 ◄

Bell & Gossett Co. ***Booth #62***

8200 N. Austin Ave., Morton Grove, Ill.

• O. F. Johnson, W. E. Peugh, H. F. Ilker

Dualex airborne teleprinting and control equipment with the exclusive Dualex tone coding for reliability; an all-electronic transistorized adapter for serial-to-parallel translation of all coded signals.

Bendix Aviation Corp., Pacific Division ***Booth #39***

11600 Sherman Way, No. Hollywood, Calif.

• C. L. Caldwell, H. D. Wilkinson, E. W. Copeland

The Pacific Division of Bendix Aviation Corporation is engaged in the design, development and manufacture of electronic systems and components for radar, sonar, missile guidance, telemetering and data transmission.

Boesch Mfg. Co., Inc. ***Booth #57***

135 River Rd., Danbury, Conn.

• A. H. Boesch, A. Melillo

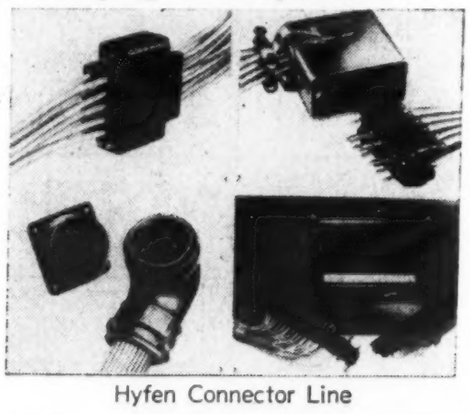
Featuring the 300 Semi-Automation, fully automatic Toroidal Winding machines.

Burndy Corp., Omaton Division ***Booths #3, 4***

Norwalk, Conn.

• H. Buttner, F. March, T. Nestler, D. Carwithen

Electrical connectors and electronic components for OEM, electronic, military and aircraft industries; featuring Hyfen line of solderless connectors with crimped pins and sockets that snap-lock into plug or receptacle.



Hyfen Connector Line

► See ad on page 71 ◄

Capitol Radio Engineering Institute ***Booth #12***

3324 16th St., N.W., Washington, D.C.

• E. H. Reitzke, E. A. Corey, D. M. Agnew, Albert Preisman, L. M. Upchurch, J. R. Kelley, Earl Radabaugh

CREI listed in "Health Education & Welfare Directory" — Higher Education; member National Council of Technical Schools; home study and residence curricula accredited Engineer's Council for Professional Development.

CGS Laboratories, Inc. ***Booths #53, 54***

391 Ludlow St., Stamford, Conn.

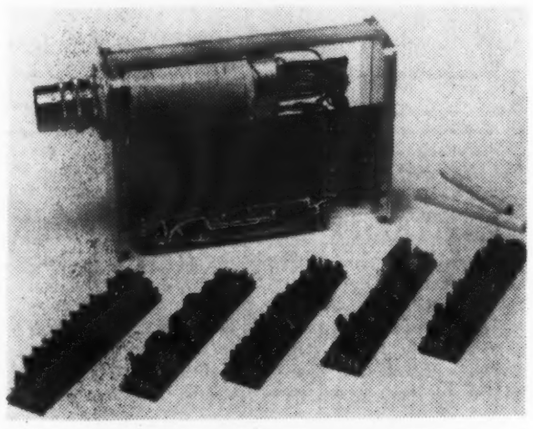
TRAK Panoramic Receivers

INCREDUCTOR High Frequency Saturable Reactors

TRAK Multicoupler

Fixed-Frequency Monitors
Countermeasures Systems
TRAK Communication Products

Dage Television Division, Thompson Products, Inc. ***Booth #102***
W. 10th St., Michigan City, Ind.
• J. R. Howland, W. E. Smith, J. E. Banister, S. T. Spangler, J. L. White
Automatic self-regulating TV cameras as used in Weathervision and supervisory installations. Completely transistorized, printed circuit, cameras, syne generators, monitors and systems.



Dage Model #333 Broadcast Camera

► See ad on page 87 ◄

Dictaphone Corp. ***Booth #101***
420 Lexington Ave., New York, N. Y.
• L. A. Engel, J. Lethbridge, W. C. Sturtevant
Dictaphone dictating and recording equipment featuring: Time-Master dictation machine, Dictet portable recorder, multi-channel continuous recorders and Telecord network dictation systems.

Electro Devices, Inc. ***Booth #55***
580 Main St., Wilmington, Mass.
• Fred Cain
Semi-automatic miniature toroid coil winder, featuring power driven dereeler.

Electronic Communications, Inc.
Booths #19, 20
1501 - 72nd St., No., St. Petersburg, Fla.
• H. T. Harrod, M. C. Eliason, E. F. Coy, Leslie Spencer
Electronic Communication and Navigation Equipment; Automatic Control Mechanisms; Electromechanical Actuators for Aircraft and Missiles; High Performance Aircraft Motors; Fuel Pumps; Facsimile Machines for Remote Reproduction; Aircraft Seat Belts.

Farnsworth Electronics Co., Division of International Telephone & Telegraph Corp.
Booths #73, 74, 75, 76, 77, 78
See: International Telephone & Telegraph Corp.

Federal Electric Corp., Associate of International Telephone & Telegraph Corp.
Booths #73, 74, 75, 76, 77, 78
See: International Telephone & Telegraph Corp.

Federal Telecommunication Labs., Division of International Telephone & Telegraph Corp.
Booths #73, 74, 75, 76, 77, 78
See: International Telephone & Telegraph Corp.

Federal Telephone & Radio Co., Division of International Telephone & Telegraph Corp.
Booths #73, 74, 75, 76, 77, 78
See: International Telephone & Telegraph Corp.

Gates Radio Co. ***Booth #40***
123 Hampshire St., Quincy, Ill.
• Larry Cervone, P. Nesbet
250 Watt Dogat Transmitter, Totalizing Recorder, Selective Amplifier and U.S.-I.A. Modulation Monitor.

General Electric Co., Light Military Electronic Equipment Dept.
Booths #84, 85, 86
French Rd., Utica, N. Y.

► See ad on page 40 ◄

General Electric Co., Heavy Military Electronic Equipment Dept.
Booths #84, 85, 86
Syracuse, N. Y.

General Electronic Labs., Inc. ***Booth #99***
18 Ames St., Cambridge 42, Mass.
• Victor W. Storey, Harold Herman, David Shamp, Jo Gaviano, William Dix
Telemetry receivers and transmitters, electroformed microwave components, countermeasures receivers and systems test equipment.

General Precision Laboratory Inc. ***Booth #46***
63 Bedford Road, Pleasantville, N. Y.
• J. Pike, A. F. Brundage, B. Bernstein, L. A. Smith
Automatic, lightweight Doppler Radar Navigation System for military aircraft; closed-circuit television for airborne and general military application.

Geotechnical Corp., The ***Booth #2***
3712 Haggar Dr., Dallas, Texas
• R. F. McMurray, F. E. Gaillard
Operating multichannel Analog Data FM Telemetering Voltage-Controlled Oscillators, Discriminators; Helicorder —72 data-hours on 1′ x 3′ record, 100 K-Gain Photocell Amplifier; Self-Developing Explosion Recorder.

Grimson Color Inc. ***Booth #67***
381 Fourth Ave., New York 16, N. Y.
• Dr. Seymour Rosin, Madison Cawein, Charles Bryant, Franz Ehrenhaft, Capt. Pierre Boucheron, USN(Ret.)
The Scanoscope wide screen closed-circuit television system for industrial, commercial, educational, sports events, military and other uses. Also makers of the Reticle Tube for special electronic uses.

► See ad on page 35 ◄

The Hickok Electrical Instrument Co. ***Booth #29***
10514 Dupont Ave., Cleveland 8, Ohio
• J. L. Walls, Robert Kerzman
Electrical and electronic testing equipment and meters.

Hoffman Electronics Corp., Hoffman Laboratories Div. ***Booth #44***
3740 So. Grand Ave., Los Angeles 7, Calif.
• Messrs. McLean, Gelly, Clark, O'-Brien, Davis
Demonstrations of solar energy conversion; electro-mechanical apparatus and capabilities; military and industrial products; space vehicles instrumentation.

► See ad on page 53 ◄

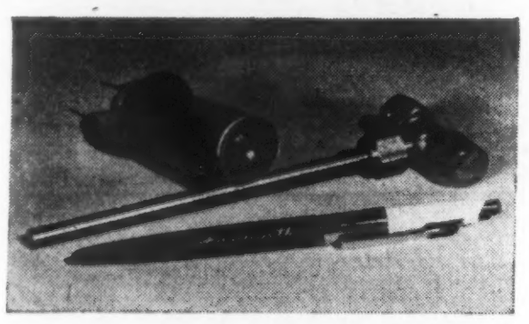
Inso Products, Ltd. ***Booth #11***
404 Fifth Ave., New York 18, N. Y.
• J. I. Cohn, H. J. Fremont
Thin wall 600 V. and 1000 V. Teflon Insulated Wire and miniaturized Class "H" Teflon Multi-Conductor Cables.

Institute of Radio Engineers ***Booths #93, 94***
1 East 79th St., New York 21, N. Y.
"Proceedings of the IRE," IRE Directory. Convention Report, Professional Group Transactions, Membership Information.

► See ad on pages 75, 103 ◄

Intelex Systems Inc., Associate of International Telephone & Telegraph Corp.
Booths #73, 74, 75, 76, 77, 78
See: International Telephone & Telegraph Corp.

International Telephone & Telegraph Corp., Farnsworth Electronics Co.
Booths #73, 74, 75, 76, 77, 78
3700 E. Pontiac St., Fort Wayne, Ind.
• L. J. Williams
Special purpose tubes, small infrared lead teleuride cells and cryostat.



Doped Germaninum Infrared Detector Cell & Cryostat

► See ad on pages 50, 51 ◄

International Telephone & Telegraph Corp., Federal Electric Corp.
Booths #73, 74, 75, 76, 77, 78
Route 17, Paramus, N. J.
• R. J. Stone
FEC serves the electronic industry by: siting, installing, tuning and testing, operating, maintaining, evaluating electronic equipments or systems, by providing training, technical publications, spare parts provisioning and over-all major project management.

FED's DEW Line Equipment in Arctic

► See ad on pages 50, 51 ◄

International Telephone & Telegraph Corp., Federal Telecommunication Labs.

Booths #73, 74, 75, 76, 77, 78

500 Washington Ave., Nutley, N. J.

• E. J. Felesina

Radio Aids to Air Navigation and Traffic Control, including TACAN, VOR-TAC-DMET, TACAN Data Link, ATC Transponder, lightweight TACAN data processing and missile guidance systems.

► See ad on pages 50, 51 ◄

International Telephone & Telegraph Corp., Federal Telephone & Radio Co.

Booths #73, 74, 75, 76, 77, 78

100 Kingsland Rd., Clifton, N. J.

• P. M. Friedman

FTR facilities are equipped for design, development and manufacture of complex airborne and ground electronic systems in the fields of: navigation, communications, identification, countermeasures, guided missiles and special devices.

FTR's VORTAC Distance Measuring Equipment

► See ad on pages 50, 51 ◄

International Telephone & Telegraph Corp., Intelex Systems Inc.

Booths #73, 74, 75, 76, 77, 78

22 Thames St., New York 6, N. Y.

• D. D. Bulkley, J. R. Tusso

Teleprinters complete with answer-back unit, transmitter distributor and reperforator; Telegraph Scrambler; Handie-Talkie Radio Transmitter Receivers; Mil type Capacitors; Electronic Telegraph Cryptographic Equipment.

INTELEX Teleprinter

► See ad on pages 50, 51 ◄

International Telephone & Telegraph Corp., Kellogg Switchboard & Supply Co.

Booths #73, 74, 75, 76, 77, 78

6650 S. Cicero Ave., Chicago, Ill.

• W. J. Caprata

Multiplex equipment, weapon systems communication (ATLAS), SAGE, Strad transistorized techniques industrial relays.

► See ad on pages 50, 51 ◄

Jerrold Electronics Corp.

Booths #21, 22

15th & Lehigh, Philadelphia 32, Pa.

• Fred Leiberman, Jerry Hastings

Integrated closed-circuit systems for multiple points of source and distribution, including training, briefing, surveillance and data systems. (The planning, installation, operation and maintenance thereof.)

Jones & Lamson Machine Co. ***Booth #13***

Springfield, Vt.

• A. J. Gebow

FC-14 Optical Comparator: A precision machine which inspects and measures all kinds of parts and products speedily and accurately.

Kellogg Switchboard & Supply Co., Division of International Telephone & Telegraph Corp.

Booths #73, 74, 75, 76, 77, 78

See: International Telephone & Telegraph Corp.

D. S. Kennedy & Co. ***Booth #100***

Cohasset, Mass.

• C. W. Creaser, K. H. Lippitt, Fred Hart, Jr.

Giant antennas for Tropo Scatter, radar, tracking and radio telescopes; waveguide components, horns and duplexers.

► See ad on page 1 ◄

Kleinschmidt Labs., Inc. ***Booth #45***

County Line Rd., Deerfield, Ill.

• Messrs. Anderson, Burnett, Clark, Frick, Geiser, Lambert, Murdock

High-speed printed communications equipment; page printers; reperforators; transmitters and components for switching systems.

► See ad on page 89 ◄

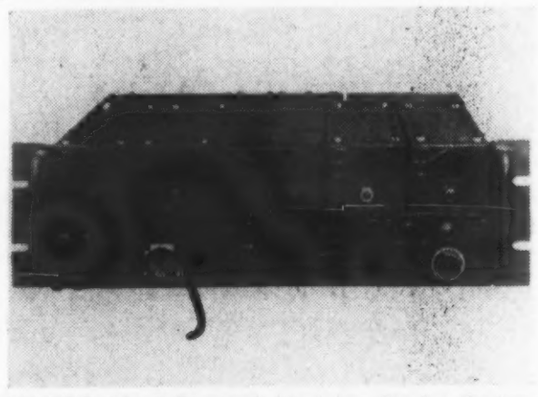
Lenkurt Electric Co., Inc.

Booths #37, 38

1105 Country Rd., San Carlos, Calif.

• R. G. Carpenter, T. A. Combellick, H. C. Kahrmann, J. A. Kuypers, P. E. Meier, R. R. Robertson, F. H. Russell, J. R. Sherman

Exhibit highlights: AN/TCC-24, 4-channel, miniaturized, transistorized, carrier system for spiral four cable or radio transmission; 74A-MICROTEL radio system; 45BX-SSB carrier multiplex system.



AN/TCC-24, 4-Channel Modular Carrier System

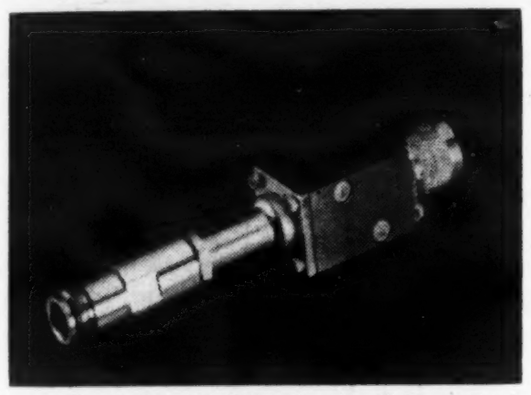
► See ad on page 2 ◄

Microphase Corp. ***Booth #63***

Box 1166, Greenwich, Conn.

• N. F. Ergul, Selim Temel, Charles Malinow, Robert Baker, Robert Fleishman

High performance RF Filters, VHF-UHF—Microwave, standard and special designs to meet critical requirements. Transmission line and waveguide filters, preselectors, diplexers, multiplexers.



Narrow-Band Coaxial Filter in the X-Band Region

► See ad on page 94 ◄

Miles Reproducer Co., Inc. ***Booth #6***

812 Broadway, New York 3, N. Y.

• J. M. Huhlik, H. B. Huhlik

Lightweight, self-powered miniature recorder: records within 60-foot radius; no wires, plugs or background noise; records stationary or mobile; pinpoints any part of an 8-hour record; cost of record only 3¢ per hour; reduces need for transcribing inasmuch as records are permanent and may be filed and mailed.

Motorola Communications & Industrial Electronics, Inc. ***Booths #9, 10***

4501 W. Augusta Blvd., Chicago 51, Ill.

• Gene Bird

Motorola display will feature electronics systems for missiles and aircraft as well as two-way radio and microwave

MOTOROLA INC.

MILITARY ELECTRONICS DIVISION

Chicago-Area Center

2710 N. Clybourn Ave. • Chicago, Ill.

Western Area Center

8201 McDowell Road • Phoenix, Arizona

communications systems for various ground communications uses.

► See ad on page 67 ◄

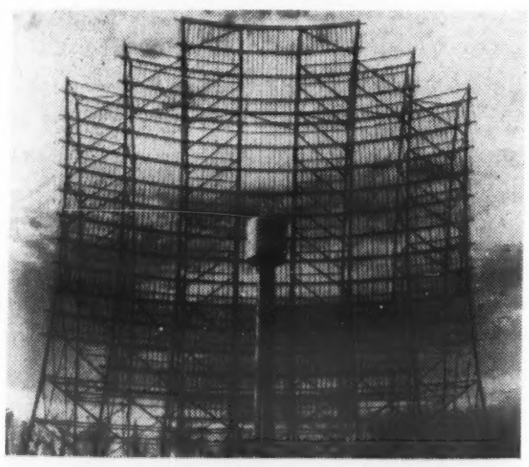
Nems-Clarke Co. ***Booths #25, 26***
Division of Vitro Corp. of America
919 Jesup-Blair Dr., Silver Spring, Md.
• A. S. Clarke, J. F. Whitehead, K. B. Redding, R. P. May, W. H. Kimbell, A. D. Babbitt
Telemetry receiving equipment including multicouplers, preamplifiers, spectrum display units and receivers covering frequency range of 40-900 megacycles; Broadcasting and Television equipment.

► See ad on page 86 ◄

North Electric Co. ***Booth #79***
553 S. Market St., Galion, Ohio
• C. Conry, W. Tucker, R. Stone, W. Reagan
Telephone and communications equipment: Relays; ERICO—one piece telephone; High-speed RVF rotary switch —any combination up to 30 inputs and/or outputs per bank level, 2, 4, or 6 levels, dust enclosed.

Northern Radio Co., Inc.
Booths #87, 88
143-9 W. 22nd St., New York 11, N. Y.
• S. A. Barone, A. J. Odgers, F. C. Lambert, J. S. Harris
Frequency shift communications equipment including keyers, converters, twinplex units, dual diversity receivers with highly stable variable master oscillators, AM & FS tone keyers and converters and regenerative repeater.

Page Communications Engineers, Inc.
Booth #31
710 Fourteenth St., N. W., Washington 5, D. C.
• H. H. Schenck, Edwin Dyke, Paul Rockwell, Ross Bateman, Kenneth Klise, F. W. Donkin
Telecommunication systems design, procurement, construction, installation, testing, personnel training and contractor-technician services.



PCE Mark II Piggy-Back Antenna

► See ad on page 34 ◄

Phelps Dodge Copper Products Corp.
Booth #7
300 Park Ave., New York 22, N. Y.
• F. W. Lemly, H. M. Edwards, H. E. Schutte, Jr., R. E. Plant, V. Clunet, F. C. Gray
Complete line of air dielectric coaxial cables with their fittings.

Philco Corp., Tech-Rep. & Government & Industrial Divisions
Booths #109, 110
4700 Wissahickon Ave., Philadelphia 44, Penna.
• J. Herre, N. Dewees
Technical training services, microwave communications and TRANSAC computer components.

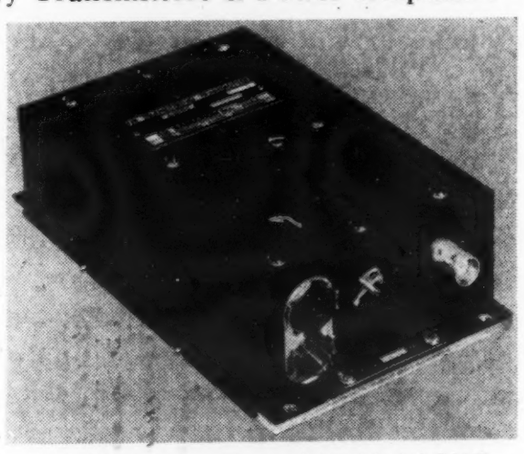
► See ad on page 80 ◄

Prodelin, Inc. ***Booth #56***
307 Bergen Ave., Kearny, N. J.
• L. A. Bendon, A. Haselman, Alan Lankin
STIR-O-LINE and SPIR-O-LOK, semi-flexible aluminum coaxial cable and connectors; parabolic antennas; EIA standard rigid coaxial transmission line; G-LINE assemblies.

Production Research Corp. ***Booth #27***
Thornwood, N. Y.
• J. A. Ford
Research, development and production facilities in electronics, electro-mechanics and optics.

Professional Book Co., Inc., Conference Book Service ***Booth #5***
3209 Columbia Pike, Arlington, Va.
Books of all publishers of particular interest to participants in the conference (military & electronics field).

Radiation, Inc. ***Booth #60***
P. O. Drawer 37, Melbourne, Fla.
• C. J. Underwood, J. Peterson, R. W. Huffman, E. Herrburger, R. Sanford, W. W. Dodgson, Jr.
Teleprinter Test Set for distortion measurement and Regenerative Repeater licensed by Automatic Telephone & Electric Co. Ltd. of England; Telemetry Transmitters & Power Amplifier.



FM Telemetering Transmitter Model 3115

► See ad on page 97 ◄

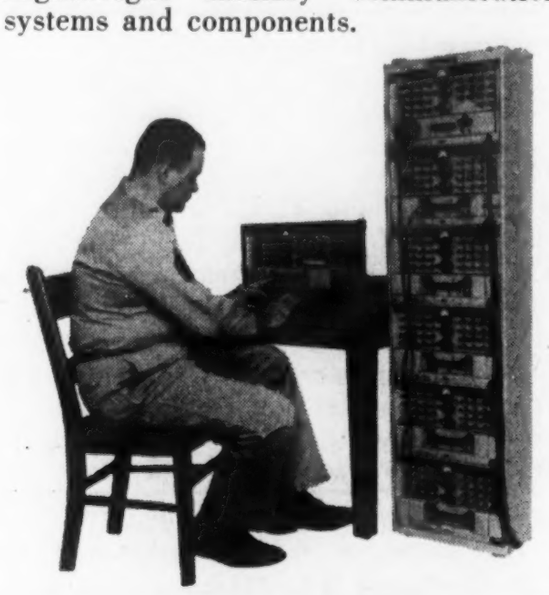
Radio Corporation of America, Defense Electronic Products
Booths #49, 50, 51
Camden, New Jersey
• W. W. Shoaf, G. R. Daggy, J. R. Dunn, T. F. Shannon
Institutional display showing electronic equipment for the Military.

► See ad on 3rd Cover ◄

Radio Corporation of America, Semiconductor Div. ***Booth #58***
Somerville, N. J.
• R. Wick, Govt. Sales Mgr., and staff
Exhibit feature an operating display showing developmental Gallium Arsenide Diodes operating at 280°C (536°F) in a bath of molten lead. Also: Developmental Silicone 175°C (347°F) and a Germanium Transistor operating at 80°C (176°F) in a bath of silicone; Samples of RCA Transistors.

► See ad on page 21 ◄

Radio Engineering Products
Booths #41, 42
1080 University St., Montreal 3, Que.
• Ernest Jungbluth
Lightweight military communication systems and components.



► See ad on page 84 ◄

Raytheon Manufacturing Co.
Booths #103, 104
103 River St., Waltham 54, Mass.
• Wilbur Small, Jack Boland, Ed Sizer
Research services for missiles, radar, sonar; transistors and power tubes.

► See ad on page 59 ◄

Rixon Electronics, Inc. ***Booth #28***
2414 Reedie Dr., Silver Spring, Md.
• J. L. Hollis, C. J. Harrison, R. E. England, J. A. Long
Custom engineering and manufacturing by communications specialists. See some of our recent developments including transistorized terminal equipment for voice and digital communications systems.

► See ad on page 90 ◄

Skydyne, Inc. ***Booths #82, 83***
River Road, Port Jervis, N. Y.
• Robert L. Weill, Walter Clevenstine, W. F. MacCallum
Transit cases, test benches and reusable containers for electronic instruments and delicate equipment; sandwich material and molded fiberglass; standard molded fiberglass cases for portable equipment.

Solartron, Inc. ***Booth #52***
530-532 Cooper St., Camden 2, N. J.
• Dick Ridgewell
New Mark II Transfer Function Analyzer: A dynamic response test instrumentation for missile development, production or operation which simplifies procedure of response testing of systems and introduces altogether new norm of accuracy and certainty.

Stelma, Inc. ***Booth #47***
190 Henry St., Stamford, Conn.
• I. Gallatin
Electronic Communications Equipment

Stromberg-Carlson Co., Div. of General Dynamics Corp. Booths #90, 91, 92
100 Carlson Rd., Rochester 3, N. Y.
• Messrs. Conolly, Beardsley, Sperling, Turner, Sager, Mayo, Sheets; Electronics Div.—Sheve, Smith, Hanson. Telecommunications Products: LABIL, NAVTAC, electronic switching equipment, transistorized terminals and associated equipment.

► **See ad on pages 43, 44** ◄

Sylvania Electronic Systems
Booth #48
A Div. of Sylvania Electric Products, Inc.
100 First Ave., Waltham 54, Mass.
• J. W. Donoho, P. O. Engelder, T. T. Hill. A. W. Christopher, E. P. Homburg
Exhibit will feature research and development capabilities on defensive missile systems, electronic warfare systems, data processing systems and related equipments and components.

► **See ad on page 95** ◄

Technical Materiel Corp., The
Booths #32, 33
700 Fenimore Rd., Mamaroneck, N. Y.
• Messrs. Galione, Deans, Matson. Craft, Carter, Erickson
Communications Equipment and other related equipment.

► **See ad on pages 62, 63** ◄

Teletype Corp. ***Booths #23, 24***
4100 Fullerton Ave., Chicago 39, Ill.
• R. A. Larsson, H. L. Unverricht, C. E. Ozimek, H. A. Wahlstrand, R. B. DePoy
Teletype Corporation's exhibit will feature the new Model 28ASR composite set with a variety of reperforators and tape readers; also 600 wpm tape equipment.

► **See ad on page 99** ◄

Tenney Engineering, Inc. ***Booth #43***
1090 Springfield Rd., Union, N. J.
• M. S. Schletter, R. H. Brown
TENNEY-MITE High and Low Temperature Test Chamber; operating temperature range −120° F. to +350° F.

Texas Instruments Incorporated, Semiconductor-Components Div.
Booth #70
6000 Lemmon Ave., Dallas 9, Texas

U. S. Department of Labor, Bureau of Apprenticeship & Training
Washington 25, D. C. ***Booth #66***
• M. M. Hanson, Elliott French, Ted Weyn
Exhibit depicts services of the U. S. Dept. of Labor, a graphic summary of the manpower future of the U. S., population trends and their manpower implications as estimated 1955-1956.

Western Electric Co.
Booths #15, 16, 17
North Carolina Works
Lexington Rd., Winston-Salem, N. C.
• J. G. Minto
The Bell System's role in invention, development and manufacture of transistors. Present-day transistors and their functions will be shown, featuring their use in Explorer I.

Western Union Telegraph Co.
Booths #80, 81
60 Hudson St., New York 13, N. Y.
• W. W. Alvis, W. H. Bowen, Ruby Gerholb, G. I. McFatter
Private Wire and Facsimile Services. High Speed Facsimile and Flat Bed Scanning.

Westinghouse Electric Corp., Electronics Div. **P.O. Box 1897, Baltimore 3, Md.**
Booths #105, 106, 107, 108
• Gary Waldorf, Tom Cawley, Bill Hulse, Dick Beatty, Ed DesLauriers, Charley Arthur
Applications of military systems in radar, communications, missile control, and data processing and display. Also, the Electronics Division STACOT transmitter for military communications.

► **See ad on page 77** ◄

Zoomar, Inc. ***Booth #18***
55 Sea Cliff Ave., Glen Cove, L. I., N. Y.
• Walter Steuer
Optics for television cameras. Optics for guided missile research.

Fidelity Sound Co. ***Booth #89***
1429 L St., N.W., Washington 5, D. C.
• Lee Deane
Tape Recorders—special applications

Radio Eng. Labs., Inc., Booth 71, **29-01 Borden Ave., L. I. City. Type 2002 M Path Test Set for Tropo Scatter. See ad p. 23.**

Editorial (*Continued from page 7*)

come to realize that their leaders see the issue quite clearly, far clearer sometimes than do we and our Allies of the free world. They recognize that the clash of ideologies is so basic that in the ultimate, no compromise is possible.

I do not doubt that they would, long since, have submitted the issue to the terrible arbitrament of war were it not for the fact that they have had reason to doubt the outcome of such a conflict. As long as we remain strong militarily and economically, we will perpetuate that doubt and the Kremlin will prefer the tactics of the cold war.

From their viewpoint, they count on a loose coalition of democratic states. They count on the bitterness and rancors engendered by past wars. They count on the envy of the poor and impoverished nations toward the rich and opulent United States—the strange anomaly of human nature that causes the receiver of the gift to resent the ability of the giver to make it. They count on the American love of soft living. Finally, it seems that they count on our American habit of impatience, our habit of coming to grips with our problems, of tearing them apart, of making decisions, and then turning our attention to other matters.

The most effective way in which we can repair these fissures in our armor is to consciously develop in ourselves a patience to take the place of our impatience—a patience based not on the fatalism of the East, but rather a patience based on knowledge and understanding. To help provide that knowledge and understanding is one of the reasons why the leaders of industry and defense are in assembly at the Twelfth Annual Convention of the Armed Forces Communications and Electronics Association.

Within recent years we have built up in the United States an industrial capacity which derives its strength from continued research, development and technological know-how. Our one best chance to remain economically and militarily strong, and of avoiding total war, will depend as much as anything else on these elements of progress and on the continued development of industrial organizations which have the capacity to act quickly should our security be challenged. For research, development and technology is truly the trine of future progress.

ARMY RESEARCH and DEVELOPMENT in C. and E.

This is the first public statement given by Lieutenant General Arthur G. Trudeau as Chief of Army Research and Development. The article is based directly on an address given by General Trudeau on 1 April 1958 at the regular monthly meeting of the Washington Chapter of AFCEA. As his first public statement as Army Chief of Research and Development, General Trudeau provides an important blueprint for future Army research and development in communications and electronics.

THE EFFECTIVENESS OF an army, today and in the future, is measured by its ability to move, to shoot, and to communicate. In all three of these areas—mobility, firepower, and communications—the United States Army relies heavily on electronics.

Consider the impact of electronics on command control. Command control today requires rapid assembly and evaluation of facts, and rapid and dependable communications in order to permit an immediate and sound determination of the optimum tactical solution. It requires a military nerve system superior to anything yet achieved. Increased use of military electronics, in all its forms, appears to offer the solution to these requirements. Through electronics, the mechanics of reaction time are theoretically limited only by the speed of light. We are all amazed and even bewildered at the electronic devices available today that solve the most complex problems and make difficult decisions with a speed, effectiveness, and degree of accuracy that can never be approached by the human brain.

In contrast. George Washington and Napoleon could only control their forces through the use of mounted messengers. The Civil War saw the beginning of military electronics, in the introduction of telegraphy, but control on the battlefield was still by mounted messenger, bugle, or visual signal. World War I introduced telephony and telegraphy as an everyday tool of command, and placed us well on the road to making electronics a commonplace part of military life. World War II saw these means of communication expanded into a system capable of controlling forces deployed over most of the world. New electronic means were developed to locate targets, to guide and control the vehicles and weapons of war, and to perform many logistic and administrative functions. In World War II, electronics gained full recognition as an essential factor in rapid control and movement of forces.

Since World War II, we have continually developed new weapons and new means of delivery in order to obtain increased and more effective firepower—both offensive and defensive. With today's coming of age of nuclear weapons and guided missiles, the manner in which a commander controls his forces has had to be revised again. Survival and victory on the atomic battlefield require that we disperse our combat troops in small, independent battle groups, and then bring them together rapidly and precisely at the decisive point of battle. There will be a much greater frequency of movement of combat elements through the air as well as over the land, creating the problem of moving not in two but in three dimensions. More information will be needed, and will be transmitted and received by more users, both within and between our tactical and logistics systems. We cannot permit the enemy to disrupt our communication systems or to discover what our intended actions may be. We want our electronic facilities to have at least the same speed, flexibility, reliability, mobility, and air-transportability as other elements of our combat system.

To meet all these requirements, we are now developing a truly modern, flexible and reliable Army communication system—built on the sound foundation of our previous communication system which, in World War II and the Korean War, has proved itself superior to any communication system of any army in the world. Under test now, for example, is tropospheric scatter—transmission systems which will give greater ranges to communication with considerable savings in operating manpower. The increased speed of movement in warfare has led us to investigate the use of air-transportable *packages* of communication equipment. Helicopter-borne or airlifted radio relay stations can provide a mobile and flexible method of overcoming obstacles to communica-

As a field commander in and out of combat, I have learned the hard way just how important communications and electronics are to success in battle. As a former Chief of Army Intelligence, I acquired further appreciation of the vital contribution made to our national security by our communications and electronics industry and military facilities.

Lt. Gen. Arthur G. Trudeau, USA

tion—such as extended distances or mountainous terrain of the type found in Korea. Communication centers can be mounted in helicopters or in air-lifted shelters for quick movement to new locations. We have developed such a capability in Korea in the last year, but suitable equipment is very scarce.

Coupled with a high-speed communication system, electronic data processing equipment can quickly analyze information about enemy forces to provide the commander with information he must have to arrive at sound decisions. We are using electronic data processing in some of our logistical activities, and we are rapidly adapting this technique for other uses. One of our fastest-growing infants, electronic data processing will in the very near future provide us with a vast number of advantages that we do not yet have, such as storage of data, computations using this "memory," analysis of information and similar functions for our combat and support activities. This will give the commander vitally necessary information, faster, in greater quantities, and in more usable form than he has ever had before.

There are still more military applications of communication and other electronics which we need. There are the navigation aids and other methods for controlling the thousands of Army aircraft which we will use. To reduce the effectiveness of enemy electronic devices, we require electronic countermeasures and, in turn, counter-countermeasures. We need electronic systems to detect atomic bursts, predict fall-out patterns, and collect and collate data for damage assessment. We need better detection devices for mines, and for chemical or biological warfare.

Many a combat commander dreams of that ideal situation when he will carry around with him a small "black box" that will tell him the tactical situation instantly, accurately, and completely. Then, theoretically he would only need the elusive push-button to place him among the great Captains of History.

Such a "black box" is, of course, only a soldier's dream. But we are developing electronic systems to reduce reaction time and increase responsiveness to new requirements in the tactical situation. These systems will enable the commander to advance or to change direction of movement, and to concentrate or disperse forces at speeds and over distances that were recently considered impossible. Thus he will be able to apply his maximum force at the right spot and at the decisive moment.

One communication advance that is nearer at hand than that ideal "black box" is telephone toll or trunk dialing. Rare is the combat soldier who has not wished for the day when he could dial a few numbers and quickly contact someone else a great distance away—eliminating the difficulties of being manually routed through several switchboards. We are currently developing an automatic switching system that will give us this capability throughout the field army, at battle group level and above. We are also testing a mobile version of radio switching centrals, a technique now used commercially. These mobile centrals will let us tie a number of people into our communication system in a fluid situation without the use of wire.

Combat Surveillance

In the field of combat surveillance —the acquisition of information about the enemy and his activities— we are moving toward the time when we will have many advanced electronic techniques for collection and presentation of the data required for sound command decisions. New types of surveillance devices will gather data to be transmitted over the communication system to all interested commanders and staff, and simultaneously into data processing equipment as well.

The commander must have information on fleeting targets with sufficient speed and accuracy to permit destruction of these targets before they disappear or take action against our own forces. The range of missiles in our fire support units covers hundreds of miles. At present, we cannot gain information about the enemy at such distances except by using substantially the same type surveillance capabilities which we had at the end of World War II and in the Korean War. Obviously, we cannot properly employ weapons with ranges of hundreds of miles without a commensurate increase in our target acquisition capability. Here is one of the greatest challenges we face today—the development of our long-range combat surveillance capability. We cannot wait until a tactical situation has crystallized to act upon it. We must be able to deduce from information furnished by our combat surveillance systems an indication of the trend of impending events before they actually happen.

To improve our combat surveillance capabilities, we are developing medium-range and short-range reconnaissance drones. These drones can carry a wide variety of sensory devices—such as radar, infrared equipment, television, or conventional cameras. Small, lightweight, portable radar sets will cover avenues of approach to battle groups, and will warn of enemy movements including infiltration and guerrilla action. To increase our ability to see in darkness or other poor visibility conditions, we are investigating very high-speed film, better radar and infrared devices, and more sensitive television. For night photography, we have in development a new airborne photographic reconnaissance camera that will provide its own illumination by automatic flare ejection. We are examining every conceivable method of providing commanders with better ways to gather intelligence data and target information so that the ground soldier can find, fix and destroy the enemy—not only at long range, but also just over the next hill.

In the field of fire control electronics, electronic computers as well as guidance and control systems for our guided and ballistic missiles will let us predict their performance and apply their firepower with increasing accuracy and effectiveness. As one indication of progress in this area, the Army satellite Explorer I was placed into orbit with a difference of only two miles in the planned and actual perigee, or minimum distance from the earth.

In the area of electronic training, electronic simulators already available enable us to train our missile crews more quickly, efficiently, and economically than if they trained only on actual missiles. But we want better training simulators for our missiles, tanks, and aircraft.

There is another field with a vast potential, a field I shall call for want of a better term: ammunition and missile electronics. These are primarily the "one-shot" electronic components used in rockets, guided missiles, warheads and shells. The VT or proximity fuze is probably the best-known example of the application of electronics to this field. When it was first developed, the small VT fuze radar mounted in the nose of a shell was a marvel of the electronics art and science. Since that time, however, great strides have been made in this field, and our requirements for one-shot electronic devices are increasing—not

RCA TRANSISTORS

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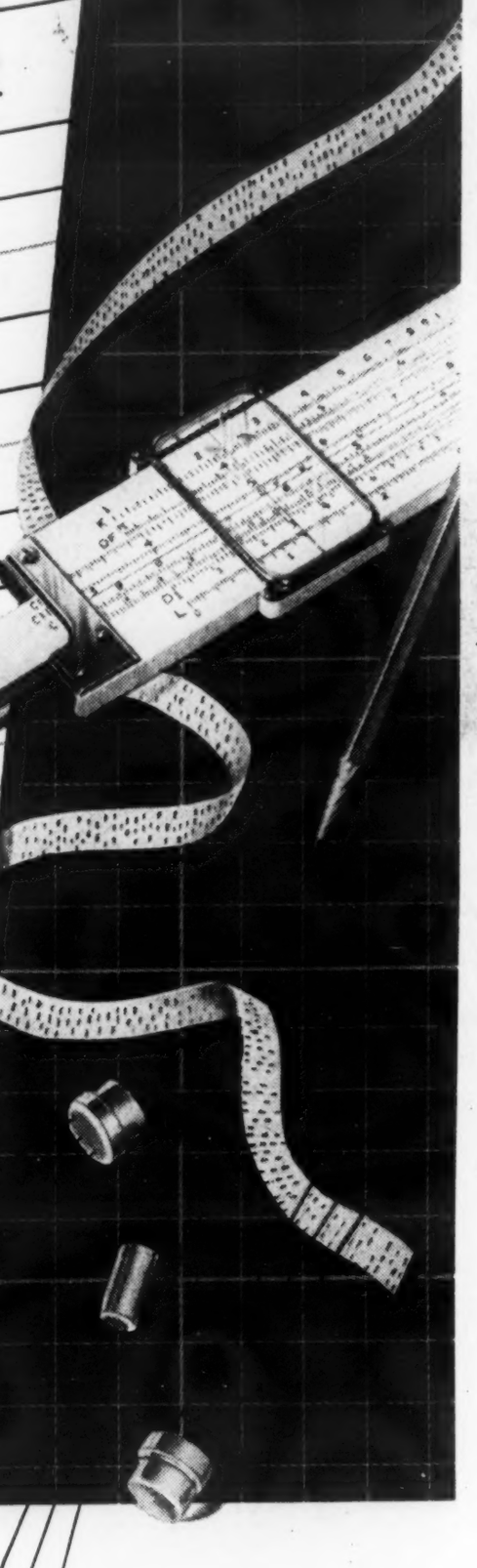
Type	Typical Alpha-Cutoff Frequency-Mc	Typical DC-Current Transfer Ratio Value at Collector Ma.	Maximum Collector Ma.
n-p-n Types for Medium-Current Switching Applications			
NEW 2N356*	3	30 at +100	+500
NEW 2N585*	5	40 at +20	+200
n-p-n Types for High-Current Switching Applications			
NEW 2N357*	6	30 at +200	+500
NEW 2N358*	9	30 at +300	+500
p-n-p Types for Medium-Current Switching Applications			
NEW 2N581*	8	30 at −20	−100
2N404*	12	40 at −20	−100
NEW 2N582*	18	60 at −20	−100
NEW 2N583	8	30 at −20	−100
2N269	12	40 at −20	−100
NEW 2N584	18	60 at −20	−100
p-n-p Types for High-Current Switching Applications			
NEW 2N578*	5	15 at −400	−400
NEW 2N579*	8	30 at −400	−400
NEW 2N580*	15	45 at −400	−400
p-n-p-Type for High-Voltage (−105 Volts) Switching Applications			
2N398*	0.7	60 at −5	−100

*Made in proposed Jetec size-group 30 Case



...a comprehensive line offering superior performance in computer designs

RCA's line now includes 14 types specifically designed to meet the demand from computer manufacturers for electrically *uniform and reliable* transistors. Your RCA Field Representative or your authorized RCA Semiconductor Products Distributor will be glad to discuss with you the many advances being made by RCA in this area of electronics. Specify *RCA* transistors for *your* computer designs. For technical data on specific types, write RCA Commercial Engineering, Section F-60-NN Somerville, N. J.

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MIDWEST . . . Suite 1154, Merchandise Mart Plaza, Chicago, Ill., WHitehall 4-2900

WEST . . . . . 6355 E. Washington Blvd., Los Angeles, Calif., RAymond 3-8361

GOV'T . . . . . 224 N. Wilkinson Street, Dayton, Ohio, BAldwin 6-2366

1625 "K" Street, N. W., Washington, D. C., District 7-1260

RADIO CORPORATION OF AMERICA

Semiconductor Division — **Somerville, N. J.**

only for conventional and atomic artillery but also, and most urgently, for our rockets and missiles.

Since Korea, all-out production of electronic fuzes has not been required. Hence only a few manufacturers have a thorough and current knowledge of these devices. Ammunition and missile electronics pose a challenge that is vastly different from that presented by other electronic equipment. For example, in the case of communication electronics we strive for reliability and long life. In simpler terms, we expect the item to work 999 times out of every thousand we turn it on. In ammunition and missile electronics, on the other hand, we strive for an item that must work right the first time and the only time it is used—for it then serves to destroy itself.

The designer working on ammunition and missile electronics is thus faced with the same problem that has always plagued the ammunition designer. He can deduce the performance of his product by simulation. But he can prove it only by destroying the item.

Ruggedness, too, takes on a completely new meaning in ammunition and missile electronics. Electronic components in missiles and shells must withstand a very high order of shock, acceleration, vibration, and other known factors of their use and environment. In the case of the satellite Explorer I, previously unknown factors were encountered such as internal temperature.

Since volume and weight usually go together, and since both of these factors are critical in the design of missiles and artillery shells, ammunition electronics must be designed with minimum weight and bulk. One criterion in the field of ammunition electronics is: "If you can see it, it's too big." And this remark probably contains more truth than wit. The printed transistor which we have recently developed is a most important step in our progress toward microminiaturization. We need more advances like the printed transistor.

There is one more factor that complicates ammunition electronics. Ammunition, unlike some other military items, must always be in a ready state. We can never be sure when we will need it. It must, therefore, be designed to be stored indefinitely without deterioration, ready for use by troops who are not electronics experts.

I have outlined some of the areas in electronics and communications in which the Army is making progress, and other areas in which we still face great problems. Military electronics has really only begun to produce all the many new capabilities we need. Many of the necessary techniques are already known, and I am sure it is merely a matter of time until we can adapt them for Army use.

Among the promising areas in which we are already making real progress are improved power sources, high-speed facsimile transmission, components to reduce size even further, and new materials to reduce weight—particularly in the equipment which is man handled or designed for air transport or air drop.

Problem Areas

There are some problem areas of particular concern to the Army. Let's consider these particular areas.

There must be greater realization and greater anticipation of the tremendous, yet unavoidable, amount of wear and tear electronic devices must take from the time they leave the industrial production line and enter the supply system to the time they are put into the hands of the using soldier.

There must be more accelerated scientific and technological progress. In this connection, we may tend too much to think of a scientific or technological breakthrough as the result of one flash of genius by one man. That is seldom true. Many breakthroughs are achieved as the result of the steady, patient efforts by many men over a long period of time.

There must be even more use made of the marvelous electronic computers available today. One principal reason why our scientific and technological progress today is so rapid is our increasing use of these computers. Up until their advent, progress was limited to the speed at which man's mind could proceed through the logical sequence of setting up a hypothesis, determining the experiments necessary to test it, carrying them out, and establishing the validity or falsity of the hypothesis. Today we still use the same logical sequence of hypothesis, experimentation and conclusion—but the process is speeded up, perhaps a millionfold, through the use of electronic computers. If, for example, we had no electronic computers at our Army Ballistic Missile Agency, we might still be trying to determine exactly what happened on last year's missile tests. With computers, this information is available to us almost immediately after conclusion of the test. In many cases, it is not even necessary to launch an actual missile to find the answer to a specific problem. Computers now available will simulate a missile flight under the desired conditions and come up with an answer in less than the elapsed time of an actual flight. In practically every field of science and technology today, electronic computers make it possible to telescope time. They also make it possible to lift the burden of time-consuming calculations from our scientists and engineers, and free their minds for truly creative effort. These wonderful devices in no way relieve us, however, from the vital need to expand our scientific and technically trained manpower.

There must be far more automation in our logistics and administrative systems, and in air defense and counter-missile systems, such as Missile Master and Nike Zeus.

And particularly, there must be greater use of the module principle—so that defective electronic components can be readily replaced under field conditions, or even under fire, by the soldier who uses the equipment.

He is, in a very real sense, our customer. Every item of electronic equipment we develop must meet his rigorous requirements. Electronic and communications equipment must be his servant—not his master. Better equipment, more effective equipment is our goal.

Accelerated Efforts

In the days ahead we must depend upon accelerated efforts in all fields of interest as our nation becomes increasingly aware of the peril presently confronting it and moves to combat it. Our civilization—our very way of life—finds the strands of security, government, industry, labor, agriculture, and culture so inextricably woven together that the failure of any one of these can rip the entire fabric apart. Individually and collectively we can all do more—and better—than we have been doing. Let us resolve to advance those American ideals and interests that have raised us to the point where we are free man's sole hope of preventing the darkness of the Communist slave state from spreading over the entire world. The Torch of Liberty is lighted by the blood of courageous men and held aloft by their progeny. I hope that we of this generation will remain worthy of our heritage.

Shores of Tripoli

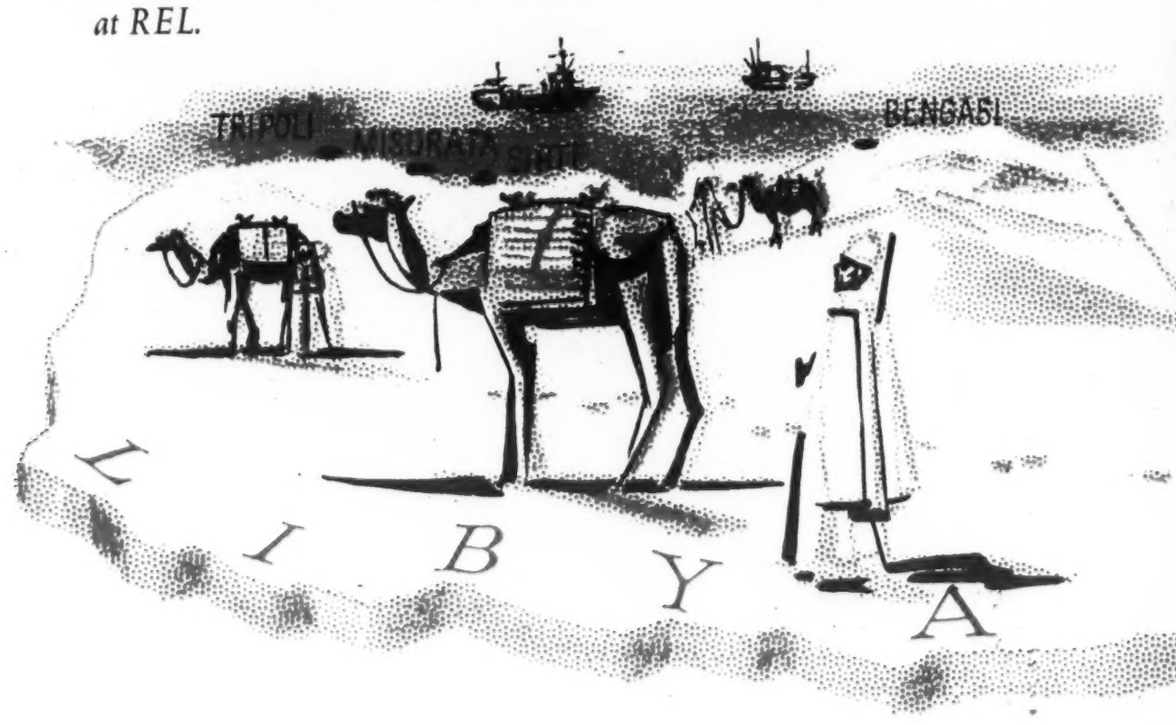
A most advanced communication network engineered by Hycon-Page Libya is being manufactured for the ancient shores of Tripoli. Civil and military service for the United Kingdom of Libya will be provided by a national telecommunications system.

For the tropo scatter spans, Hycon-Page Libya has chosen radio equipment by REL: driver exciters, 1 kw and 10 kw klystron amplifiers, diversity combiner receivers, and special test apparatus. The ultimate traffic capacity of these tropo links will be forty-eight telephone channels.

REL packaged systems have demonstrated in repeated testing their ability to withstand the extremely high temperatures (110° to 115° daily in the shade) and dust storms which will be encountered in desert installation.

The reliability for which REL equipment is world famous is a product of both imagination and experience. More kilowatt miles of tropo scatter equipment by REL are in use and on order than those of all other companies combined.

The skill and facilities for solving your specialized radio problems are available at REL.



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Radio Engineering Laboratories·Inc.

A subsidiary of Dynamics Corporation of America

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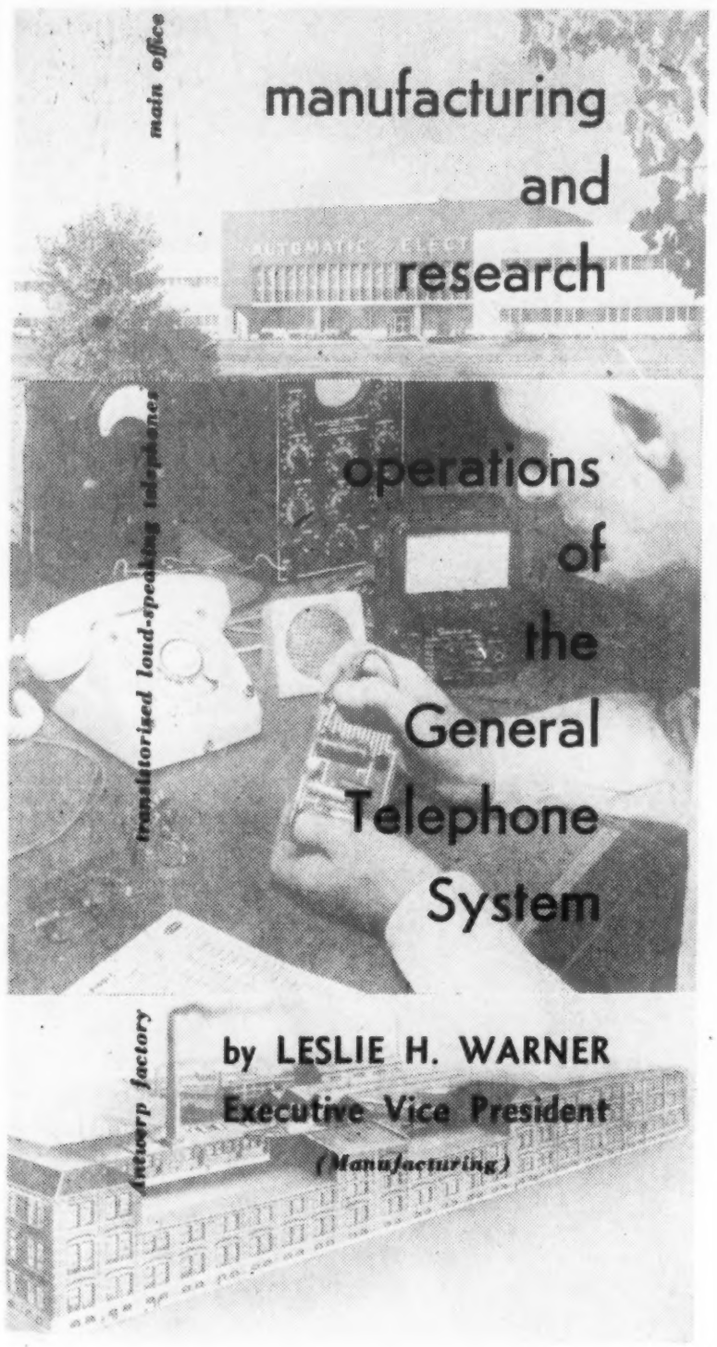

THE STORY OF THE fast growing General Telephone System has been told many times, especially with reference to its telephone operating companies now providing telephone service in thirty states and several foreign countries. Few people realize, however, the important significance of General's manufacturing and research operations which now account for over 40% of the System's gross revenues and represent one of the most important growth factors in the System.

At the present time, General's manufacturing and research operations embrace eighteen manufacturing, sales, research and service companies employing a total of approximately 12,500 people. Collectively, these companies make up one of the largest communications equipment manufacturing and research organizations in the world, and their domestic operations in the United States are second in size and scope in the telephone manufacturing industry only to those of Western Electric Company. Consolidated sales of General's manufacturing and sales companies totaled over $210,000,000 in 1957 and it is expected that such sales will increase substantially in the future.

Automatic Electric Company

Largest and best known of General's manufacturing units is Automatic Electric Company, acquired when Theodore Gary & Company was merged into the General Telephone Corporation in October, 1955.

The story of Automatic Electric Company began nearly seventy years ago when Almon Brown Strowger invented automatic telephony. The company was organized in 1891 to undertake the manufacture and sale of this revolutionary new device, and the first automatic telephone system in the world was installed the following year in La Porte, Indiana—which, incidentally, is one of the cities now served by the General Telephone System.

This initial installation proved conclusively that the automation of telephone calls was possible long before the word "automation" was ever thought of, and the Strowger step-by-step system was the forerunner of all subsequently developed types of automatic telephone equipment.

Gaining acceptance of automatic telephony was a slow and sometimes painful undertaking, but the public liked the new service and the independent telephone industry in this country was especially quick to recognize the advantages of the "girl-less, wait-less, out-of-order-less" telephone system as it was called in newspaper and magazine articles during the early, pioneering days of Automatic Electric's history. Today, over 80% of all the telephones in the world are operated automatically and it has been estimated that approximately two-thirds of all of these millions of dial telephones are operated with step-by-step equipment stemming from Strowger's basic invention.

From its small beginning in a little shop on Chicago's Clinton Street in 1891, Automatic Electric has grown to a company employing over 8,000 people in one of the most modern manufacturing plants in the world. Just last October, Automatic completed its move into its new plant which provides over 1,500,000 square feet of floor space on a 170-acre former country club site in Northlake, a western suburb of Chicago. With these new facilities, the company is now in position to increase its productive output substantially.

In addition to its basic product—Strowger step-by-step central office telephone equipment — Automatic Electric manufactures complete lines of telephone station apparatus, pay stations, power boards, toll equipment, private intercommunication systems, electrical control components and systems, and other apparatus associated with the communications industry.

Automatic telephony constituted essentially one of the first great strides forward in the automation of industrial processes. From this original concept have stemmed many of the automatic control systems so common today. In fact, such control mechanisms as exemplified by the totalizator, teleregister equipment, automatic teletypewriter switching systems, and many others are direct outgrowths of Automatic Electric's development of the automatic telephone system. As these fields opened, Automatic Electric built up a highly respected technical reputation in the automatic controls field, and many components, particularly relays and switches, are supplied by Automatic to other manufacturers for incorporation into their own products. Today, an important segment of Automatic Electric's business lies in the development and manufacture of high quality electrical control components for industrial and military use. Telephone type relays and switches manufactured by Automatic Electric are used in fully automatic teletypewriter switching systems, in computers such as Univac and Computyper, in electronic bookkeeping machines, in aircraft and guided missiles, in data processing systems, traffic control systems, automated machine tools, and hundreds of other applications.

But the most modern machines and laboratory apparatus along with the 8,000 skilled workers, technicians and scientists at Automatic Electric's plant in Northlake are only a part of the General Telephone System's integrated, world-wide manufacturing and research organization. Other factories owned by General are located in Genoa, Illinois; Waukesha, Wisconsin; Brockville, Canada; Antwerp, Belgium, and Milan, Italy.

Leich Electric Company

Leich Electric Company, located at Genoa, Illinois, was the first manufacturer of telephone equipment acquired by General Telephone Corporation. This company was founded in 1907 and was acquired by General in 1950.

Early engaged in the manufacture of manual magneto and common battery equipment and telephone instruments, Leich later pioneered in the development and manufacture of all-relay type automatic central office equipment for small and medium size exchange use. The Leich dial system has been so well received that over 800 installations have been placed in service since its introduction in 1949.

Leich Electric Company has more than tripled its plant since its acquisition by General. The Leich factory in Genoa presently contains approximately 160,000 square feet of manufacturing, office and warehouse space, and construction work is now under way on a further addition which will provide 40,000 square feet more. The company employs over 600 people in its manufacturing operations.

The principal products of Leich are dial central office equipment, telephone instruments, P-B-X- and P-A-B-X switchboards, line concentrator units, ringing converters, and other miscellaneous communications equipment items.

Electronic Secretary Industries, Inc.

Electronic Secretary Industries, Inc., is the most recent addition to the group of manufacturing companies owned by the General Telephone Corporation, having been acquired by General in February, 1957.

The company was founded in 1949 to manufacture and promote the sale of an automatic telephone answering and recording device, known as the Electronic Secretary, and has pioneered in this field with substantial success. Recently, the company has developed another ingenuous new product—an automatic, electronic warning device known as the Electronic Sentry—which will soon be available. The Electronic Sentry can be actuated by high or low temperatures, water levels or pressure, burglary, and various other emergency conditions. When actuated, the Electronic Sentry will dial a predetermined telephone number electronically and report the emergency condition by means of a recorded message. It will continue to call the predetermined number and repeat the message until the condition which caused the Electronic Sentry to activate has been corrected.

Electronic Secretary Industries, Inc., occupies a new, 24,000-square-foot plant in Waukesha, Wisconsin, which was just completed in August 1957. The company employs approximately 85 people in its manufacturing operations.

International Operations

Extensive manufacturing operations outside the United States are carried on by manufacturing subsidiaries of Automatic Electric International, Incorporated, located in Canada, Belgium and Italy.

Automatic Electric (Canada) Limited began operations in 1935 in Brockville, Ontario, to manufacture automatic central office equipment and telephone instruments for the Canadian market. In 1954, the company built a new modern factory and office building in Brockville providing 125,000 square feet of space, but the requirements of the Canadian communications industry have expanded so rapidly during recent years that it was necessary to nearly double the size of the Canadian plant in 1957. Automatic Electric (Canada) Limited now operates in approximately 225,000 square feet of floor space and employs over 1,200 people.

Automatique Electrique, S. A., located in Antwerp, Belgium, was founded in 1892 and acquired by Automatic Electric International in 1926, at which time it began manufacture of Strowger step-by-step equipment. This company, one of the two principal manufacturers of telephone equipment in Belgium, employs approximately 1,500 people.

In addition to the manufacture of automatic telephone equipment and telephone instruments, Automatique Electrique, S. A., manufactures electrical measuring and recording apparatus and conducts a sizable operation in the manufacture of slide fasteners (zippers). The company was instrumental in pioneering achievements in the automatic toll dialing field, and the first installations of automatic toll ticketing equipment in the world were made in Belgium by this company in 1937.

The Belgian factory presently contains approximately 170,000 square feet of floor space, but a 33,000-square-foot addition to the plant is now under construction.

Automatic Electric S. A. T. A. P., located in Milan, Italy, was established by Automatic Electric International in the early 1930's to manufacture Strowger step-by-step equipment for the Italian market. The company is housed in a modern 180,000-square-foot plant and employs more than 1,000 people.

Automatic Electric S. A. T. A. P. is now one of the principal suppliers of automatic central office equipment and telephone instruments to the Italian telephone companies and also exports substantial amounts of communications equipment to other countries throughout the world. Within the past few years, the company has set up an electronics laboratory and has made marked advances in the carrier area.

Sales Operations

General Telephone has developed a far-flung, comprehensive sales organization employing more than 1,000 people to serve its expanding manufacturing operations throughout the world.

Sales of the products of the General Telephone System manufacturing subsidiaries are handled exclusively in the United States and its territories by Automatic Electric Sales Corporation and Leich Sales Corporation. Sales abroad are handled by Automatic Electric International and its sales subsidiaries.

In addition to handling the sale of System manufactured products, these companies also serve as distributors for a complete line of communications products manufactured by other companies. These products include Lenkurt carrier and radio equipment, wire and cable, poles, tools, hardware, and virtually everything else that goes into a modern telephone plant.

At this point, it is pertinent to mention General Telephone Corporation's association with Lenkurt Electric Company, Inc., of San Carlos, California.

Lenkurt is a relatively young company, established some fifteen years ago, and is engaged exclusively in the development and manufacture of carrier and radio equipment for communications use. Automatic Electric Company holds a one-third financial interest in Lenkurt, and acts, through its affiliated sales companies, as the exclusive distributor of Lenkurt products to the independent telephone industry, to industrial users, and in export.

Lenkurt employs over 2,000 people, and is one of the most outstanding manufacturers of carrier and radio equipment in the world. The company maintains subsidiary assembly plants in Vancouver, British Columbia, Canada, and in Mexico City.

General Telephone Laboratories

General Telephone Laboratories, Incorporated (formerly Automatic Electric Laboratories, Inc.), is the research and development arm of the General Telephone System.

Prior to the acquisition of Automatic Electric Company by General Telephone Corporation, the Laboratories company devoted its principal efforts to the development of products directly related to the communi-

A graduate of the University of Wichita and the Harvard Graduate School of Business Administration, Mr. Warner has served as President in each of General Telephone's principal manufacturing and sales companies during the course of his career.

cations industry which were subsequently manufactured by Automatic Electric and its affiliated manufacturing companies. The operations of Laboratories are now being expanded, however, to include research and development work in other fields, material and product testing, and the establishment of equipment and material standards for the General Telephone System.

To provide facilities for these expanded research and development activities, one of the most modern and completely equipped communications laboratories in the world was constructed as an integral part of Automatic Electric's new Northlake plant. Included are such features as a completely equipped transistor laboratory, anechoic chambers for acoustical experiments, hot and cold rooms for temperature and climatic tests, and devices for conducting vibration, life and environmental studies.

It is from this organization that have come such outstanding achievements as automatic toll dialing and ticketing equipment, the loudspeaking hands-free telephone, the modern self-contained telephone instrument, and many other advances related to automatic telephony. Currently, General Telephone Laboratories is well advanced in development work on electronic switching systems and on other electronic devices which have practical application in the communications field.

General Telephone Laboratories employs approximately 180 scientists, engineers, technicians and other staff members at Northlake. In addition, supplementary research on specific products is carried out by the engineering staffs of each of the General Telephone System manufacturing companies. This is particularly true with respect to the Belgian and Italian factories where the specialized needs of their customers abroad differ substantially from those of telephone companies operating in the United States. All of this supplementary research and development work is coordinated with General Telephone Laboratories at Northlake, however, and there is a constant inter-exchange of information and mutual assistance between the Laboratories and the technical staffs of the individual manufacturing companies.

The General Telephone System takes pride in the fact that its Laboratories and manufacturing subsidiaries rank high among the world's leading producers of communications equipment. As the originator of automatic telephony, Automatic Electric is regarded throughout the world as the mother company in this industry, and all present forms of dial switching systems as well as many other types of automatic control systems so common today have stemmed from the basic idea developed and pioneered in by Automatic Electric.

At the dedication ceremonies for Automatic Electric's new Northlake plant held on October 17, 1957, Mr. Donald C. Power, President of the General Telephone Corporation, emphasized that many good things depend upon the speed and certainty of communications with each other and with the rest of the world. Progress, understanding, personal and national safety, and peace of mind are among them.

The General Telephone System is very much aware of its responsibilities in providing this vital service, and its manufacturing and research companies are dedicated to the development and manufacture of ever new and better communications products which will go far toward removing the barriers of distance and time which now separate the peoples of the world.

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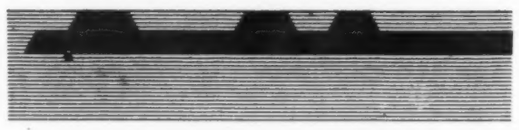
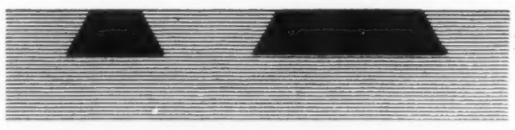
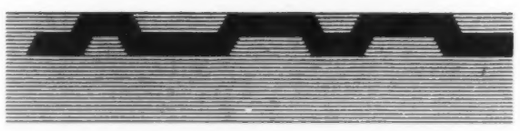


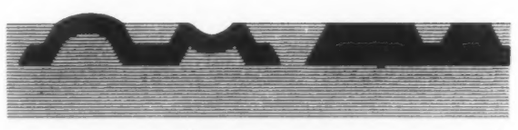
FLUSH CIRCUITRY
Flush with surface of the laminate . . . locked in place . . . any size, shape, or capacity.



FORMED CIRCUITRY
Modern, fast method of making circuitry . . . flush or imbedded . . . can be produced entirely mechanical.



SWITCH CIRCUITRY
Contact areas raised, flush, or detented for switching action . . . rigid or flexible . . . reliable.



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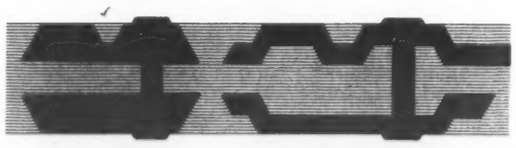

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300 EAST FIFTH STREET • ST. PAUL 1, MINNESOTA

by
RAdm. Henry C. Bruton, USN
Director of Naval Communications

Some Problems in Naval Communications

NUCLEAR WEAPONS, NUCLEAR power and missiles provide the U. S. Navy with weapons systems of fantastic power for our own defense and with an effective deterrent to any possible enemies.

A major element in the control and coordination of all these new weapons systems is what we in the Navy call "the Voice of Command"—Communications. Unless our communications capability keeps pace with advanced weapons systems, we may well have lost the battle before it starts. The vital necessity of adequate communications in the Military Services is never questioned. However, constant vigilance is paramount lest communications be taken for granted or be treated as an *afterthought*. Speed is the theme of today almost everywhere.

We in the Navy are attempting to meet this requirement in several ways—by automatic switching, high-speed crypto, increased teletypewriter speeds and of course, increased use of private nets.

Our automatic switching program currently provides for five large relay centers to serve naval activities in the continental United States. It will handle several categories of precedence, as well as multiple addresses, with a 200 wpm cross-office speed. Installation will commence this year. A subsequent program will take care of our overseas relay centers. This program will speed teletypewriter communications and conserve operation personnel.

We are making definite progress to reduce and virtually eliminate cryptographic delays by the use of new, secure, practically automatic equipment. All this will speed communications, particularly classified traffic, and will conserve operating personnel.

Our new teletypewriter equipment is designed for 100 wpm speed. We expect to go to this speed on selected circuits very soon. By 1961, we hope to effect a complete changeover to this higher speed. By that time, also, our use of data transmission will have greatly increased, both ashore and afloat. But with all of this, the Navy will not abandon the use of manually keyed CW. Perhaps someday we will, but that decision is one for the future.

Another one of our major requirements is *reliability*—that much abused and variably defined term. Everybody is completely satisfied with 100%; practically nobody accepts less. This is almost like the end of the rainbow, and once in a while we almost get the pot of gold in sight, but never quite.

The Navy is improving reliability by increasing the use of single sideband, particularly on voice circuits. We have several hundred low-power commercial equipments in the Fleet now, with good performance and a fair degree of reliability.

Like the other Services, we are increasing our use of wire, cable and microwave.

We are making increased use of old reliable LF and VLF on Fleet broadcasts and ship-to-shore circuits. These frequencies are particularly valuable in the polar regions. Your Navy is the world's biggest user of VLF. VLF is highly reliable for one-way broadcasts and can be received by submarines when completely submerged, with no part (not even the antenna) projecting above the surface. But this requires high power, and these stations are large and expensive. Many have heard about the new 1000 KW (output) VLF station we are now building in Maine. It will be the granddaddy of them all. We have a similar station programed for the Pacific. We certainly plan to use the VLF-Polaris FBM 8M weapon system.

Presently, we are installing a moon relay UHF direct link between Washington, D. C., and Pearl Harbor.

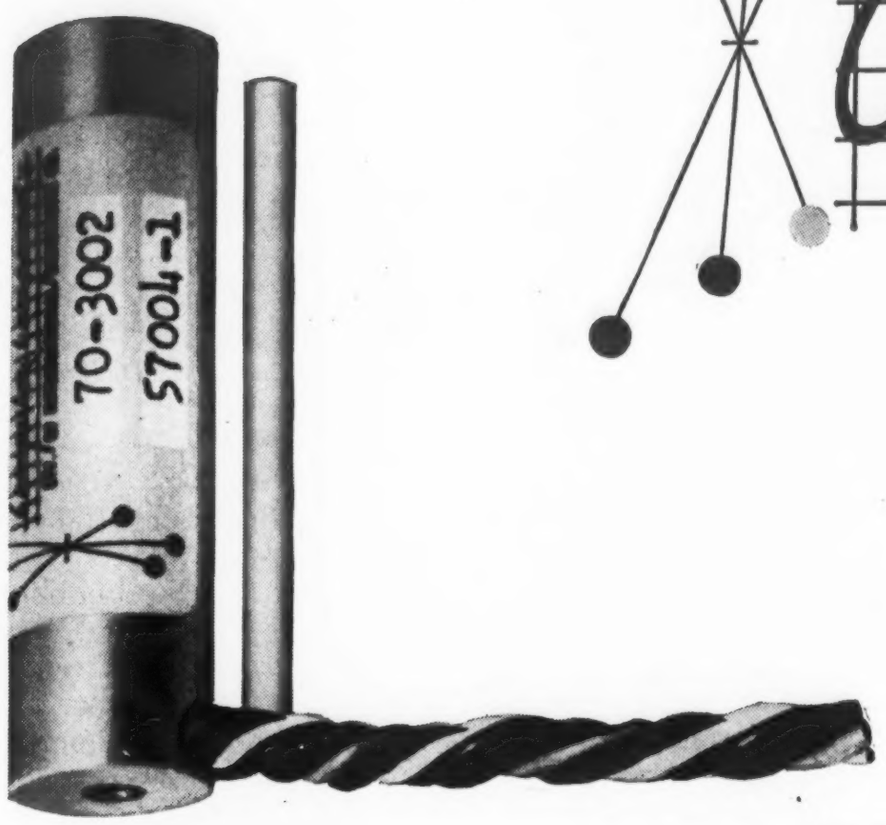
One of our biggest communications problems is in handling our heavy traffic volume. Specifically our message traffic load today, in the point-to-point system alone, is approximately five-million handlings per month. By contrast, in 1880 when both telegraph and cable were available, the Navy Department sent fewer than 20 telegrams and cablegrams a year to distant forces. The Department wrote only 101 letters that year to distant ships!

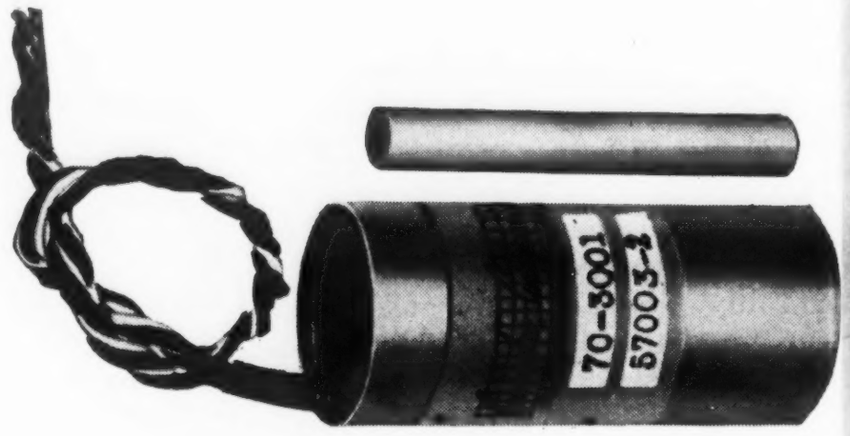
Today, the daily message traffic handled in the Navy Department in Washington alone, if stacked one message on top of another (and only one copy of each mes-

(*Continued on page* 49)

Unless our communications capability keeps pace with advanced weapons systems, we may well have lost the battle before it starts. Constant vigilance is paramount . . . Speed is the theme of today.

Compu-tran





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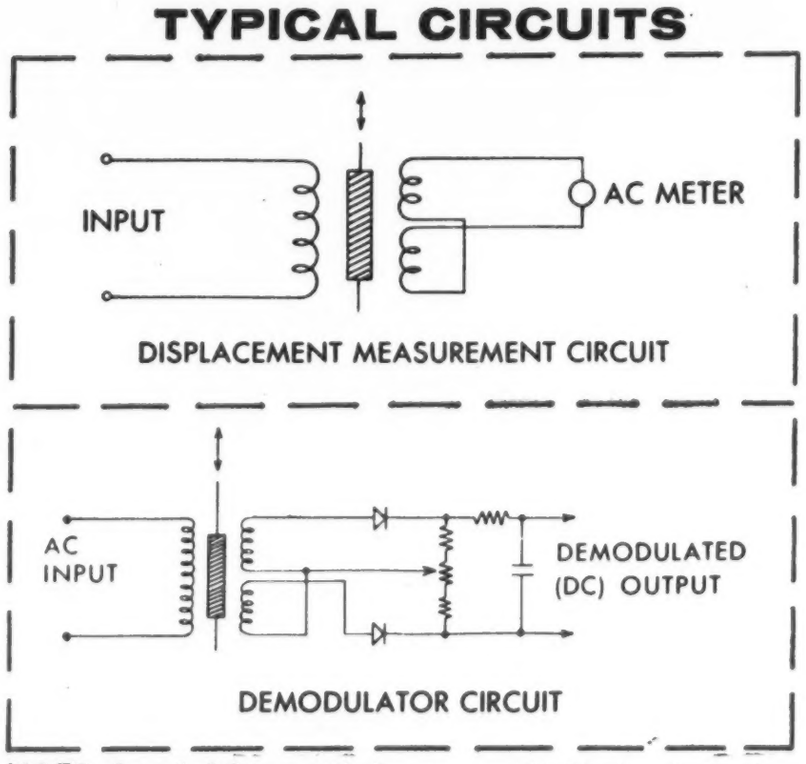

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KELLOGG SWITCHBOARD and SUPPLY COMPANY

by | *George T. Scharffenberger*

KELLOGG SWITCHBOARD AND Supply Co., one of the nine domestic divisions of International Telephone and Telegraph Corp., has assumed an ever-growing role in the American economy.

For more than half a century, Kellogg was almost exclusively a supplier for the independent telephone industry. The company's contribution by way of new equipment and techniques were many.

It was quite natural, therefore, that this experience in fine instrumentation and communications development should have led Kellogg to its present pre-eminence in the much broader field of communications.

For today, Kellogg is a recognized designer, manufacturer and installer of reliable communication systems and components—systems including multiplex, carrier, signaling, microwave, over-the-horizon and switching; components including relays, switches, apparatus and telephones.

Indicative of our work in the broad field of communications is the eightfold increase in our engineering personnel alone in the past two years. Our development and manufacturing, likewise, have grown and spread to three additional facilities within the same time span.

One of our more recent accomplishments is equipment for the first broad-band microwave system employing over-the-horizon (O/H) transmission for commercial telephone and television communication.

The new system, which utilizes tropospheric propagation at microwave frequencies is designed to handle 120 or more telephone channels or television. It will provide, in effect, an electronic "bridge" over which TV programs may be beamed for the first time over distances beyond line of sight. The way is thus paved to a whole new facet in communication systems.

Kellogg's dual role as a supplier to the independent industry and as a defense contractor sometimes interlocks. This is the case in SAGE, the semi-automatic ground environment nation-wide air defense system, which operates with the aid of civilian telephone systems.

SAGE, developed by Massachusetts Institute of Technology and Bell System engineers, gains impetus as Kellogg carries on work on the project with teams from Western Electric, U. S. Air Force and A. D. E. A. (Air Defense Engineers Services) operating with the independent telephone companies.

In the Niagara Falls, N. Y., area is the first all-independent SAGE radar site, from which invisible fingers probe the skies for approaching aircraft. This system, a joint responsibility of Kellogg and the Sanborn Telephone Company, is a prime example of how the independent telephone industry and Kellogg can combine their skills and talents to do a complete communications job for defense.

For this SAGE project Kellogg did the engineering furnishing and installation of the equipment to enable Sanborn to provide the Air Force with an operational system including air-to-ground and voice circuits.

In this joint effort with Sanborn, Kellogg continues to provide operational, maintenance, training and consulting services to insure reliability of performance. Kellogg supplied special data transmitters, data receivers and switching equipment for the air-to-ground portion of the system and also microwave, carrier, cable and other transmission equipment for the integrated system.

Another important area of activity for Kellogg at present is the Air Force's Atlas missile program in which the company is the primary supplier of ground communications.

For the Atlas program, Kellogg engineers have developed the Commswitch, a device for detecting communications failure. It monitors communications channels continuously for degradation of speech and intelligibility, and switches instantaneously to an alternate channel when the quality drops below pre-set limits.

In recent months Kellogg designed and built three experimental models of an auto-manual, ultra lightweight telephone central office for the United States Army Signal Engineering Laboratory at Fort Monmouth, N. J. Utilizing transistors instead of relays, these are the first electronic switchboards to be developed for the Army Signal Corps (Figure 1, page 30).

These new switchboards are designed to serve common battery or magneto telephones, magneto switchboards and lines to civilian manual or dial exchanges. They also employ built-in-two-voice frequency signaling for use on trunks between other switchboards of this type. In addition, each of the three models incorporates an automatic answering feature, through supervision on trunk circuits, end-to-end and stage-by-stage recall, and immediate release on all trunk circuits on a tandem connection when the first board disconnects at the termination of a call.

Based on the experimental models, a complete militarized 3-position central office, serving 180 lines, weighs 617 pounds (Figure 2). This is exclusive of batteries and is less than one-quarter the weight of a conventional 3-position switchboard utilizing relay equipment. These models, containing 15,000 electronic components and completed in less than 16 months, are currently undergoing field tests.

A new lightweight central office is

President of Kellogg Switchboard and Supply Co. as of Sept. 1955, Mr. Scharffenberger has been affiliated with I.T.&T. since 1944, is an army veteran, and was graduated from Columbia University.

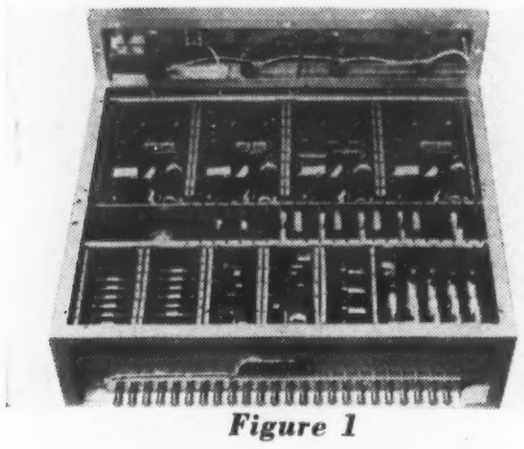

Figure 1

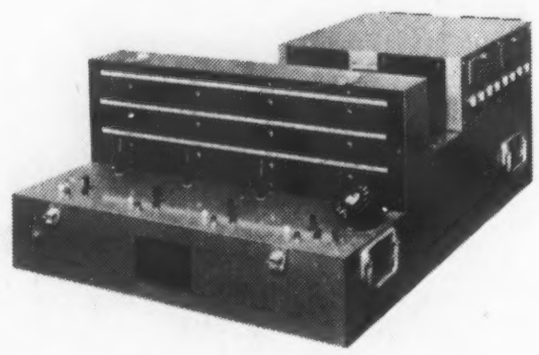

Figure 2

an auto-manual system supplied with a battery charger-eliminator and equipped with four cord circuits, four trunk circuits, four CBS (common battery signaling) telephone circuits, three magneto telephone circuits, and one civilian line circuit that can handle dial calls. The components are mounted on plug-in printed circuit cards containing 600 transistors for each of the three models.

The auto-manual system offers considerable operational advantage since the elimination of answering cords substantially reduces operator effort and the possibility of operator error. Likewise, the operator needs only to monitor the unobstructed key shelf "S" (or seizure) lamps rather than watch the much larger expanse of line lamps on the jack panel that characterize the conventional switchboard. The automatic answering system also permits automatic release of trunk circuits on tandem connections to increase the efficiency of trunk utilization.

The Kellogg-developed switchboard also incorporates numerous other special features that simplify operation and permit broader application. These include automatic ringing and ringing cut-off on calls to CBS (common battery signaling) telephones; supervisory lamps that can be checked for burnout by operating push-button switches; plug-in construction and cut-out switches which facilitate maintenance and minimize component failure, and fade immunity which prevents trunk tie-up due to loss of a signal tone by long fades in the tranmission path.

Our work, quite naturally, brings us in close working relationship with industrial firms requiring specialized components and service.

Last June, General Electric announced that "one of the most modern, efficient and automatic processing and computation centers in the missile industry" was installed in its Missile and Ordnance System Department in Philadelphia. This installation is used for processing data received from missile flight tests, from tests of missile environments and components, and for scientific computations needed for advanced studies. Such a center is necessary to simplify the design and evaluation of the increasingly complex modern weapons systems, particularly missile weapon systems.

Kellogg's development of the automatic analog switching system for the centers was termed by G. E. as "one of the most interesting components in the system."

This switching system is used to control switching all analog data signals from the telemetry translators to the analog recorders. If used as a dial telephone center, this system is large enough to service a city of 30,000 people. Its connections are made automatically at the command of a punched paper tape. "Wrong numbers" are eliminated because the system corrects its own mistakes.

Our military development and manufacture is concentrated in a facility separate from our other operations. Here, complete engineering is provided, including a model shop, printed wiring laboratory, a standard organization, a components and reliability section and complete reproduction facilities for drawings, proposals and reports.

Kellogg Projects

Complete projects and some of those currently in process include:

The FWAC—a four wire automatic signal converter for the Army's new Area Communications System utilizing new concepts in transistor circuitry and printed wiring; the AN/TCC-34, which adapts the AN/TCC-7 12-channel carrier system for radio multiplex; the Light Weight Central Office, a study of central office equipment improvements by the use of electronic switching techniques; the CV-441, a signal converter for use on HF radio circuits; the AN/FGC-29, a 12-channel telephone carrier system; the AN/TCC-3, a 4-channel telephone carrier system; the TA-187, a 4-channel signal converter and terminating set, and the TA-182, a telephone signal converter.

These equipments vary in size from the small 12-pound TA-182 to the AN/FGC-29 which contains more than 250 separate electrical assemblies and 1,000 vacuum tubes. When packed for shipment, it weighs almost 4½ tons.

Now in its 62nd year, Kellogg continues to be a basic supplier to the nation's independent telephone industry.

A proud possessor of many dramatic "firsts" in the telephone industry, Kellogg introduced its new K-60 Crossbar switching system last October. The K-60 incorporates many important advances in the telephone switching art presently not in one switching system. It represents the culmination of years of experience in techniques and continued development of Crossbar—first introduced by Kellogg—through the use of facilities of both Kellogg and associated IT&T development laboratories and manufacturing units. This equipment can be engineered for small community dial offices as well as large metropolitan exchanges.

The K-60 makes available full-terminal-per-station efficiency with the same amount of equipment needed in older techniques of terminal-per-line operation. K-60 incorporates the facility to detect fault conditions and the "intelligence" to lock the troubled paths in the conditions in which they were found. This allows every call switched through the equipment to be a routing call.

The use of register-sender type operation allows the K-60 to operate in any complex numbering area previously requiring changes in office codes. The use of register-sender type operation provides flexibility in the adaptation of office translation which in operation may add routing information or change routing information in the switching of an outgoing call.

The use of the number group translation principle allows ultimate flexibility in the assignment of subscribers' directory numbers to their associated equipment location and eliminates the need of line intermediate distributing frames. The changing of subscribers' equipment assignment can be made without the need of moving a number in the number group translator and is done by the simple relocation of small plug-in diodes within the diode matrix.

We treasure our position in the field of communications generally and in military communications particularly—the latter, a field of increasing importance and complexity in this missile age.

by Major General Victor R. Haugen, USAF

CHANGING TIMES

in weapon systems management

THE MARRIAGE BETWEEN the science of electronics and the science of systems engineering has become the overwhelming dominant factor in the generation of complex equipments we call weapon systems. The integration of these intimately interrelated elements into a system of warfare has become a major managerial problem. The effort required by the system manager to evolve and develop a modern system involving an air vehicle flying at two or three times the speed of sound—carrying a massive electronic fire control system tied through an automatic communications net to a nation-wide system for detecting enemy targets and controlling the flight of our retaliatory weapons—becomes extremely large. Obviously, a *very* well organized management system is required to cope with the problem. This is the challenge confronting every member of ARDC, AMC, and industry.

No story on system management can begin without at least a mention of the weapons system concept. I look upon the "weapon system concept" as: A *management* concept which recognizes the need for planning, scheduling, and controlling —from inception to successful introduction into the active inventory as an operating entity—the complete weapon system, i.e., the air vehicle, all of its component elements, its supporting equipment, and all effort needed to prepare it for active employment.

With this concept we have faced many challenging weapon system development tasks during the past few years. The Air Force-Industry team has achieved successes not possible without its diligent application.

Having been fortunate to be involved with various facets of this business off and on for 18 years, and in the light of this experience, I will discuss some aspects of "The Changing Times in Weapons System Management," as it appears to me.

Technology today will permit us to build high-performance flight vehicles operating at hypersonic speeds in the upper reaches of the atmosphere—or even beyond. These vehicles are causing sweeping changes in our national and military way of life. Before getting down to my basic topic—"Changing Times" —it is important to "pin up" three broad technical considerations that stem from this technology. These considerations are: *one*—the matter of technical superiority; *two*—the gaining of knowledge through the use of research vehicles; *three*—the expanding environment of our operations.

(1) *Technical Superiority*: There is a growing realization that technical superiority, as such, is emerging as a means of influencing the minds of men in the cold war. Technical strength has become a bargaining power of inestimable value among the family of nations. In the "post-Sputnik" era this observation has become almost trite, but it illustrates why it is so extremely important that this country continue as a technically superior nation. There can be no skimping on action taken to retain this superiority.

Major General Haugen is Assistant Deputy Commander for Weapon Systems, Hdqs., Air Research and Development Command, and Commander of ARDC's Detachment No. 1 at Wright-Patterson Air Force Base, Ohio.

(2) *Importance of Research Vehicles*: As man makes his assault on space, the role assumed by research vehicles takes on increasing importance, since only through the knowledge gained in the hard school of exploration in this little known region will practical space vehicles, able to perform useful missions, be achieved. The step-by-step progress, required to harness for useful purposes the five to seven and greater miles per second flight performance required in space, can be accomplished only by a well planned progressive program employing advanced research vehicles.

(3) *Expanding Environment of Operations*: Vehicles of such very high performance will encounter environment regimes which, when viewed from those encountered during the past decade, represent a significant step function. Because of this vastly expanded theater, new and difficult detection, guidance, and control problems will face us. I call this to your attention because aero-electronics, radio astronomy, and spacetronics will certainly play most significant roles in the future.

Trends Affecting Systems Management

As we all know, many significant factors influencing the problem of systems management are appearing. They are nonhomogeneous in nature, so I have not bothered to classify them by category. However, I will present them, with running commentary, as I see them "from inside weapon systems."

• Complexity: The first factor which overshadows all other influences is the extreme complexity of it all. The modern supersonic weapon, whether it be fighter, bomber or missile, is a fantastically complex affair. Forged out of the finest exotic materials, the vehicle is propelled by engines of fantastic power and is armed with the force of the atom to perform its destructive role. It uses 20th century electronics to seek out and unerringly aim and fire its missile, or to impact on its predetermined target area. No other machine on earth today approaches the engineering know-how built into these weapons. Because of their complexity, I hold that our modern weapon systems represent the most sophisti-

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AF	AF33(600)-20314	IR-Mapping — Medium Altitude.
AF	AF33(600)-21622	IR Image Velocity Detector
Sig Corps	DA-36-039 SC-67869	Drone IR Reconnaissance System
AF	AF33(038)-6415	IR Night Reconnaissance Camera Trigger
AF	AF33(038)-23317	IR Ground Reconnaissance Sets
Army	P. O. #12363-NOWPE	IR Arctic Region Crevasse Detector
AF	AF33(616)-5136	Field Service Project for IR Systems
Navy	NOa(s)-10274	IR Submarine Wake Detector

SURFACE

Sig Corps	DA-36-039-sc-12	IR Gun Flash Detector
USA Engr. R&D Lab	DA-44-009 ENG-629	Far-IR Battlefield Surveillance
AF	AF 33(600)-25854	IR Ground Reconnaissance System
AF	W28-099-ac-306	Track-while Scan Radar Equipment

GUIDED MISSILE SUBSYSTEMS AND COMPONENTS

Navy	NOa(s)-8806	AN/ASQ-4 — IR Search Set
AF	W33-038-ac-17658	A-5 Seeker, IR Missile Guidance (ASM)
Navy	NOa(s)-9142	Guidance Servo Control System
AF	AF33(038)-7325 A-4	(AAM-GAM) IR Seeker
BuOrd	N123-605305-3384A	Primary Source Standard for
ARM	Sub[illegible]ct	[illegible] Control Amplifier
Cor[illegible]r	Su[illegible]ct	[illegible]AN [illegible] Transducer

ELECTRONIC COUNTER MEASURES

AF	AF 33(038)-12742	Airborne Infrared Monochromator (WADC)
AF	AF 30(602)-1761	Infrared Source Study

BOMBING SYSTEMS

AF	AF 33(038)-17396	Far IR-Viewer for Night Bombing

DIRECTION FINDING SYSTEMS

Sig Corps	DA-36-039 SC-5606	AN/TRD-4 H.F. Radio Direction Finding Equipment
AF	AF 30(602)-1485	UHF/DF AN/GRD-11 UHF Radio Direction Finder Equipment
Sig Corps	DA-36-039 SC-72809	AN/TRD-15 HF Radio Direction Finding Equipment
Army	DA-30-069-ORD-2135	VHF Radio Direction Finding Equipment
Raytheon	Sub-Contract	AN/TRD-3 Direction Finding Equipment
LFE	Sub-Contract	AN/TRD-10 Direction Finding Equipment
Specialties	Sub-Contract	AN/CRD-2 Direction Finding Equipment

NAVIGATION SYSTEMS

AF	AF28(099)-27	Quasi-Doppler Navigation Study Program
Navy	NOa(s)-10893	AN/ASA-14 Dead Reckoning Tracer for AEW Aircraft
Sig Corps	DA-36-039 SC-42719	Target Course Generator for Error Computer
AF	AF 33(616)-3102	Airspeed Vector Direction Indicator
AF	AF 33(600)-35159	AN/APA-110 Lightweight Airborne Dead Reckoning Tracer

DATA TRANSMISSION SYSTEMS

Sig Corps	W36-039-sc-44559	Remote Arctic Weather Telemetering System
Sig Corps	DA-36-039-sc-5417	Data Transmission Frequency Control System
Navy	NObsr-49210	Ship to Ship Digital Data Transmission System for ASW
USWB	Cwb 9127-W-3581	Radiotheodolite for Weather Balloon Tracking

GROUND SUPPORT SYSTEMS AND TEST INSTRUMENTS

Raytheon	Sub-Contract	Sparrow III Components Test Station
Sperry	Sub-Contract	Voltage Analog Repeater for Hustler
Sperry	Sub-Contract	Synchro. Data Repeater for Hustler
Chrysler	Sub-Contract	Redstone Pre-set Timer
Sig Corps	W36-039-sc-38229	Dial-Calibrator
Navy	NObsr-43403	Analog Position Computer for ASW System
Navy	NOnr-01101	Airborne Radar Simulator
Navy	NOa(s)-10946	Servo Analysis Laboratory
CAA	Cca-28338	Signal Generator
AF	AF 33(038)-13205	Precision Recorder, all electronic
Sig Corps	DA-36-039 SC-15416	Direct Reading Frequency Meter
Sig Corps	DA-36-039 SC-74746	Control Recorder AN/GMD-2
Navy	N383-45488A	Universal Test Set for AN/ASA-14

CONTROL SYSTEMS

AF	W33-038-ac-17019	Servo Control System
AF	AF 30(602)-1629	Servo Control Preamplifier
AF	W28-099-ac-313	Radar Height Indicator
AF	AF 33(616)-2963	Aircraft Engine Flame Detector System
Burroughs	Sub-Contract	Azimuth Mark Generator for use in SAGE System

EMERGENCY & RESCUE EQUIPMENT

BuShips	NObsr-52237	Submarine Rescue Radio Transmitting Buoy

Changing Times

cated combination of hardware ever packed in such a small volume.

There is a further increase in total capabilities of weapons when we properly combine the air vehicle part of the system with the ground based portion. This marriage of the machine in the air and the electronic machine on the ground represents a capability hitherto unrealized. Unfortunately, this results in a complexity hitherto unknown. In fact, the operation of this combination of air-ground machines to accomplish a military mission is one of the most challenging and vexing technical problems facing the military today. Also, as we move into the space age, you will see this combining and optimizing of the air and ground capabilities expanding in application to future systems yielding systems of a higher order than we have known in the past.

• *Missile - Aircraft Convergence*: There was once a time when it was pretty easy to tell whether a vehicle should be classified as an airplane or as a guided missile, and it may be possible today. Of the many ideas and proposals I have seen recently, however, it is increasingly more difficult to tell these once distinct classes apart. Performance is certainly no criterion because manned vehicles are being proposed in the same performance regimes with missiles. Amount of electronic equipment is no criterion either, nor is the sophistication of the automation within the system. Guidance and control techniques also seem to be about the same for both.

Now, of course, I have overstated this observation, but I have a reason for doing so because the converging trends in aircraft and missile designs mean to me that we should adjust our internal organization and management procedures to recognize this trend.

• *Rise In Costs*: Our experience indicates a continuing rise in the cost of developing weapon systems. This, coupled with the fact that we are constantly asked to achieve greater increase in performance with less time, can only result in driving our costs up at an exponential rate. Because of this trend, it is essential that rapid, timely, and sound decisions are made by the Air Force, since any appreciable delay means either less than optimum design, or costly retracing or scrapping of engineering and development effort. This is particularly true in those weapon systems programs which we have accelerated in order to assure early inven-

(*Continued on page* 34)

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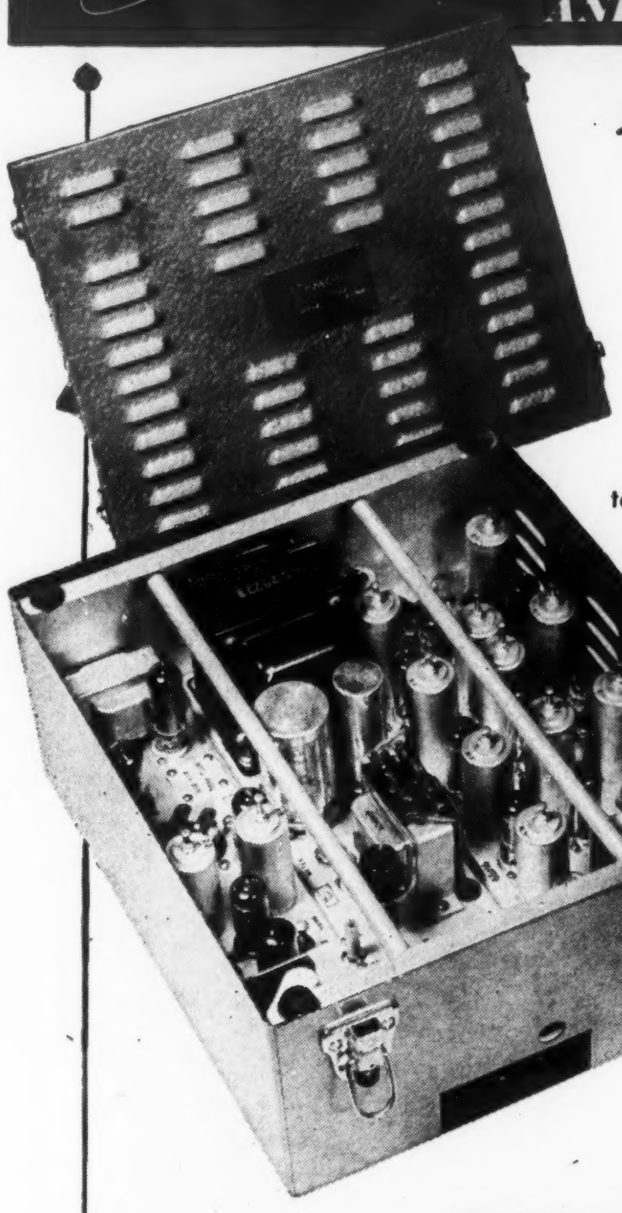

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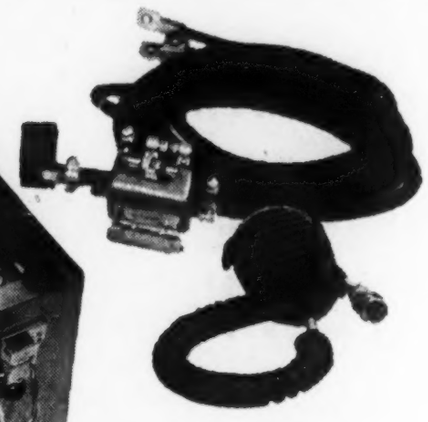

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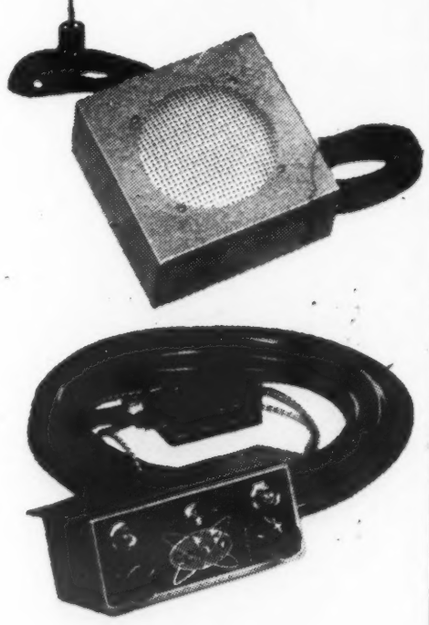

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tory dates.

• *Lessening of Numbers of Weapons*: One need only listen to the reply made by General Power, Commander in Chief of SAC, to a recent question as to the effectiveness or deadliness of today's nuclear armed bomber. General Power was asked "What is the net effect of the penetration of one bomber these days?" His immediate reply was, "One city lost." With this effectiveness of today's weapons, it is obvious that the great fleets of bombers laying down carpets of TNT bombs is a thing of the past. In its place is an inventory of select, but highly sophisticated weapons, equaling in capability the great fleets of World War II. To us this has vast implications on our development, test logistics, maintenance and supply methods. To you this will mean greater concentration of industry on fewer items.

In my observation, there is a very clear trend towards taking larger technical strides in the development of succeeding weapon systems. Let me illustrate by observing that, speedwise, the progress from the B-52 to the B-58 was greater than that achieved by all the step-by-step improvements leading up to the B-52. With this reluctance to undertake development of a weapon unless it represents a very major improvement, we will obviously undertake fewer separate developments in any particular field. Hence, it is my opinion that we can look for fewer separate weapon system developments, but those we do undertake will be real king-sized challenges. Thus, it appears that more intense competition will evolve, requiring responsive heads-up management on the part of both industry and ourselves.

• *Short Reaction Time*: It would be difficult to say precisely what length of warning we might expect if war should ever come. Whether it be measured in hours—or minutes —or seconds—I do not know. I do know that, whatever that warning may be, we must react within it to launch our defensive and retaliatory weapons—or we perish. To me this is good enough reason to recognize the need to prepare for extremely short reaction time.

The process of alerting a force, assuring combat readiness, and providing a coordinated flow of information and materiel to maintain the Fleet in a high state of readiness is adaptable to electronic data processing methods. We are currently carrying out plans to materially increase the automation of this entire process. This will create fundamental new concepts in ground test equipment, in the means used for identifying a malfunctioning part, in reporting the weapon's combat ready status, and in ordering of the part and transmitting the order automatically to the depot.

When this concept has been implemented, we may expect a revolution in the entire process of readying, launching, retrieving, and re-arming our strategic and defensive striking forces.

• *Reliability*: I have indicated a trend to fewer very complex high-performance weapon systems to be maintained alert for operations on practically instantaneous notice.

Reliability in such an operation obviously takes on a new importance and a vastly increased order of challenge. Reliability then becomes a keystone, the importance of which must be recognized in our management approach.

Changes in System Management

In an organization as large as the Air Force, fundamental change in how business is done comes slowly, as, I submit, it does in industry. Nevertheless, looking back to where we were even a few years ago, it is astonishing to note the progress that has been made. I think some horns need to be tooted about this, and I propose to do just that by relating a few of the changes which have been made, or are being made, to cope with the challenge of the trends we have just discussed.

• *Extension of the System Concept*: When the Air Force announced the "weapon system concept" some years ago, the name was carefully chosen to include the word "weapon." Now, let's back off from it a ways to see what the weapon system concept really is. We see that it really doesn't have to relate only to "weapon" systems—it can be applied as a concept for managing the development of anything. It merely recognizes the vastly improved management possible if there is an "effective line of authority assigned," whatever job is to be done. It also recognizes that if all of the elements of the job are considered as an entity, not broken apart so that subtle inter-relationships are lost from view, a complex job can be accomplished successfully and efficiently.

I submit that the concept would be better understood if we dropped the word "weapon" and called it merely the "system concept." Surely its applicability to the challenging job of developing space research vehicles would be clearer.

As we have seen, the advent of complex ground electronic supporting systems has brought into focus the existence of an order of systems larger and more fundamental than the thing we have called a weapon system. The sum of several interrelated weapon systems and supporting systems together may form the major elements of a "mission system."

In case you think I'm seeing spots before my eyes, you should visit the joint ARDC-ADC-AMC Air Defense Systems Integration Division at Bedford, Massachusetts, sometime. They think there is such a mission system in air defense. From my experience in trying to develop various air defense interceptors to operate harmoniously within our Sage environment, employing a data link tie-in to guide an automatic fire control and missile launching system, in the presence of other air defense weapons—with perhaps a few unidentified aircraft around to add interest—I think so, too.

Where does this all end Perhaps my only clue is reference to my favorite definition of a "system." I've heard it said that a "system" is something one order more complex than the thing you are working on. Or maybe you prefer Richardson's definition of a vortex—which goes as follows:

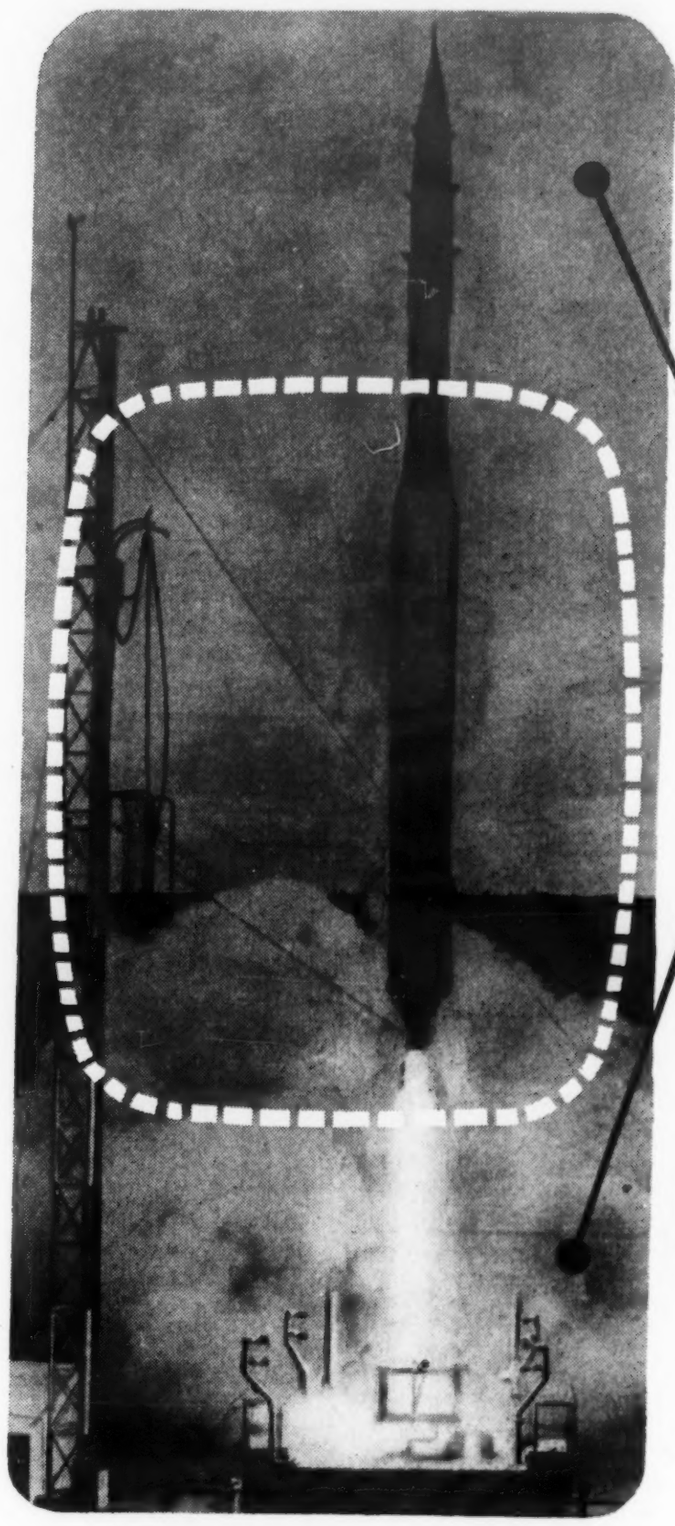
Big whirls have little whirls
That feed on their velocity;
And little whirls have lesser whirls
And so on to viscosity.

• *Streamlining of Organization*: No doubt you are all aware of the recent realignment of the organization within AMC's Directorate of Procurement and Production. This move effectively increased the stature and authority of the AMC members of the Weapon System Project Offices and was done so that they could deal more adequately with the increased challenges I have discussed previously. In another move to strengthen them, AMC is assigning Supply and Maintenance representatives directly in the WSPO's.

The ARDC move affecting WSPO's is being made. It will raise their stature in the same fashion as the AMC move and will align them in mission areas to keep abreast of the times.

One streamline move to meet the times was made approximately a year and a half ago. Then it was decided to expand the systems management apparatus of my organization to bring the major electronic supporting systems under a systems management

(*Continued on page* 36)



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concept. Prior to this time, the lack of a systems approach in electronics had resulted in a snarl of energetic confusion and a general lack of orderly approach that was retarding progress.

As a start, there was established in our organization Electronic Supporting Systems Project Offices called ESSPO's. These project offices, operating along side their better known brothers, the Weapon System Project Offices (WSPO's), represent "corporate level" management to plan, direct, and oversee the implementation of the major electronic systems to which I have referred. The ESSPO's duties are somewhat unique and differ slightly from those performed by the WSPO's in that they are not only the USAF focal point for their own electronic system, but they have an integration responsibility to discharge with respect to the aircraft and missiles which operate in their environment.

The existence of these ESSPO's operating along side the WSPO's in a total systems climate is doing much to provide the desired systems integration required of the air vehicle in its control environment.

At present there are eleven such ESSPO's in my organization, developing electronic systems for use in the majority of the Air Force mission areas.

• *Input from Using Command*: We have found that the using command *must live with us* from the very start of a new project. Its knowledge of the mission, the airborne electromagnetic warfare tactics, the global deployment, the topology of the ground electronic control installations, its maintenance and operating concepts—all must be taken into consideration early in the formulative stage of a new weapon. Thus, more and more the using command is participating with us from the very start, even including active participation in our source selection machinery.

• *Fundamentals of System Management*: To be more specific about our modern concept of system management to cope with the trends of the times, let me list a few fundamentals which distinguished my approach to system management.

- A clearly stated objective
- A sound plan of action to achieve the objective
- A clear delegation of authority to a strong action agency
- Simple, effective procedures
- Accounting for actions
- Adequate and timely support

• *Simplified Procedures:* Perhaps there are some who have not complained about the amount of data the Air Force wants to have submitted on its contracts, so I should not say that *everyone* wants us to change. Nevertheless, we are going to change some of these requirements anyway.

A recently published document describing the CDM procedure should materially improve our procedure for describing just what data we really want—and what we will no longer ask for. Through the CDM procedure (CDM means contractor developed material), the Air Force and the contractor will agree upon the basic technical approach to be followed, establish appropriate milestones, define testing requirements, and agree on how the contractor will account to the Air Force for the execution of the authority delegated to him in the contract. We intend to greatly reduce the number of reports required and to simplify the reporting procedures which, we hope, will permit the contractor to get on with the job more efficiently.

• *Revised Testing Concept*: Much could be said on our new philosophy of testing. Let me merely say that we have recognized the need to bring the using Command into the testing of weapon systems at the earliest date possible and have also recognized the need for an integrated approach to testing to increase effectiveness and economy. The result is a "task force" concept of testing in which all agencies interested in a given system pool their interests and their talents and jointly proceed with an integrated program.

Weapon Concept—What It Is Not

The what and why of the weapon system concept have been discussed quite a bit and inasmuch as misunderstanding often invades any area where changes are taking place, I cannot resist this opportunity for stating a few things along the line: The system concept—what it is not!

First, it does not mean that the Air Force abrogates its total responsibilities to industry, but rather recognizes the capabilities and responsibilities of the military-industry partnership and delegates certain specific authority in consonance with that responsibility within a framework which will permit decisions to be made on a timely basis by the partner best capable of making those decisions, and in recognition of the element of compromise always present in any development.

It is not a panacea for all the problems confronting us in an era of high performance and extremely complex military weapons, but is simply a method whereby a crew chief is designated within the Government and within industry to facilitate, expedite, and more efficiently solve the day-to-day problems requiring resolution on a given weapon system in recognition of that environment.

It does not intend to permit under Government sponsorship one element of industry to develop on its own an in-house capability in a new technical field in competition with already established and recognized industry.

It does not intend to imply or result in stagnation of R&D or technical development, but rather integrates those promising elements available to permit their exploitation in solution to a total military problem just as industry itself approaches a problem on a commercial basis.

It does not infer any retardation of exploratory research or technique development. To those of us intimately associated with weapon system development, we recognize that the weapon systems of the future are directly dependent on such R&D work being conducted today.

Conclusion

In closing let me direct a few comments to the industry members of AFCEA, and to SIGNAL readers who are representatives, particularly, from development planning offices of industry.

Because of the sweeping nature of the electronics way-of-life being pursued by the Air Force, we have a deep and continuing interest in the health and welfare of the industry that provides us with the hardware.

I have tried in this article to paint a background of the evolutionary nature of technical management caused by changes in the over-all Air Force weapons picture. From the systems standpoint, we are tackling technical tasks whose immense scope extends far beyond anything previously attempted. We are going from many vehicles to a select few. Our weapons must draw on the finest that technology will permit. The accent will be on quality, system togetherness, and reliability. Costs are rising, so much must be made of industry efficiency. The nation's defense posture is at stake, so there can be no room for other than top drawer talent properly organized to do the job. Because of the immensity of the engineering and integration tasks outlined, the electronic industry would be well advised to examine how it should mobilize to meet our demanding needs. This is the challenge.

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Automatic Electric Polar Relay is used in selector cabinet of Teleregister Corp. stock-quotation system. Teleregister design engineer, Jim Hartelius, shows how snap-on cover can be removed for visual inspection. He reports " . . . complete reliability . . . almost infinite life . . . virtually never gets out of adjustment."

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John Howland adjusting one of the cameras used for the new closed-circuit weather-vision system.

Weathervision

by JOHN R. HOWLAND—DAGE TELEVISION DIVISION—THOMPSON PRODUCTS, INC.

The theme of AFCEA's 1958 Convention, "Research-Development-Technology—the Trine of Progress," has a meaningful and significant connotation. It names three fundamental factors which contribute materially to the strength of any nation, to the production of consumer items for future economic growth and to the advancement of modern civilization. These factors have brought about breakthroughs in various scientific fields and will definitely lead the way to new achievements in the atomic age and the age of space.

Considering the field of aviation, these factors have been responsible for the rapid advancements in equipment and techniques associated with aircraft and their support equipment. But, has their contribution been limited to aircraft alone? The Dage Television Division, as a member of The Thompson Products, Inc., family engaged in research and development, manufacturing and production of any and all types of television equipment and systems, has provided the answer to this question. In cooperation with the military over a 5-year period, Dage TV Division devised the first push-button weather briefing system for military use. Weathervision TV, as it is now known, was first installed at Grand View Air Force Base in Missouri. Additional Weathervision TV systems have been installed within recent months at McGuire Air Force Base, Lakehurst Naval Air Training Station, Otis Air Force Base and on March 5, 1958 at Andrews Air Force Base in the Nation's Capital. In the words of Major General Jarred V. Crabb, USAF, "Weathervision is one more result of our undaunted efforts."

What Weathervision Did

Nobody, including the farmer, needs to know more about weather than a pilot. Weathervision has provided the means for increased efficiency at the base operations weather stations through the rapid dissemination of weather information. This represents a breakthrough in time—reducing sharply the time a fighter pilot needs in preparing for a flight and preparing fighter interceptors "on the line." In other words, weathervision, the closed-circuit TV two-way communication system, represents the latest in weather briefing for fighter pilots and other flying personnel. It is the most modern and quickest method used to date by the military to transmit instantaneous weather data immediately prior to take-off.

How Weathervision Works

Before Dage weathervision became an actuality, several different forecasters were kept busy briefing at widely separated locations and each prepared separate briefing aids. At some air stations as many as 10 duty forecasters were required for this work. With weathervision, one forecaster at the specially designed briefing console can service many outlets with up-to-the-minute information. He has at his disposal the latest fax charts with special overlays, the sequences and a remote hookup to the CPS-9 radarscope, which he can see on his monitor TV screen as it is shown to the viewers. Incidentally, the AN/CPS-9 radar set, often called the "seeing-eye," can determine how high and how wide any storm or disturbance is, its course and speed, as well as whether the cloud formation contains rain or snow.

The value of this instrument is obvious, considering its ability to spot and pinpoint storms up to a maximum of 400 miles in any direction.

From his seat at the console, one forecaster can provide complete scheduled weather briefings, handle special requests for immediate aircrew briefings, tend to the new pilot-to-forecaster service, keep the automatic telephone-answering device current and monitor the local weather with the CPS-9 weather radar scope.

Out-of-station recipients of weather information receive their briefings on specially modified, standard commercial TV sets. They have a microphone through which they can talk to the forecaster and personally discuss the vital weather information which will affect their particular mission. On the forecaster's console, a light signal identifies which of the receiving locations is asking the question.

The Dage console, containing the television camera unit, is designed around the forecaster and, in practice, is his work table. It is centrally located at the base weather station. TV sets for the receiver sites are located at various units on the base where operations or planning require immediate access to complete weather service.

Heart of the system, the console, has a small multi-lens camera to view weather transparencies, facsimile

Weathervision forecaster Captain William Frey, at the Dage Television Division console, transmits immediate weather information, charts, weather maps and other pertinent weather data, simultaneously, to fighter pilots scattered throughout Andrews Air Force Base in Washington, D. C. There are eleven television receivers employed at the base where immediate push-button weather information is available twenty-four hours a day.

charts or teletype sequences which are the basic aids used by the forecaster in his briefings. Remotely controlled lenses of varying focal length allow the forecaster to change from a wide general analysis to more detailed subjects.

Of primary use to the forecaster in his briefing is a transparent acetate, the same size as standard weather charts, upon which is outlined a basic United States map or some specific region. The current weather is indicated upon the acetate and lighted from beneath.

Surface and upper-air facsimile analyses are transcribed to the acetate with fast-drying ink. The forecaster may also use the regular facsimile charts with overhead lighting.

A voice-actuated tape recorder keeps a record of the briefing actually provided to pilots preparing their flight plans. The radio pilot-to-forecaster facilities used by pilots calling for weather information while in flight can only be operated by the forecaster directly from the console.

With the flick of a switch, the CPS-9 weather radarscope is presented on the console monitor screen and on the numerous receiver screens. This enables the forecaster to brief on the local weather directly from a radar picture of cloud formations surrounding the base.

Receivers for the closed-circuit television network on a base can be connected to the console by coaxial cable for the video, and phone lines for a two-way audio hookup. Transmission by microwave is used from operations to distant receiving stations on a base when the installation of coaxial cable becomes too costly. Each receiver has a "push-to-talk" microphone for requesting a briefing and asking questions.

Conclusion

Based on the use of weathervision in the relatively short span of time it has been in operation, the Dage closed-circuit TV and two-way communication system is credited with great savings of time, money and personnel and with increases in operational efficiency. With weathervision one thing became a certainty. The procedure time to secure a flight clearance has been cut down by eliminating the usual travel to and from "base operations" to complete the clearance form and save time for the forecaster as well as the pilot.

Major Lewis J. Neyland, AWS, who has been spearheading weathervision work, recently had this to say: "It now appears that a weathervision system may prove in time to be an indispensable part of the communication system of most large modern air bases with widely scattered, diversified types of air operations."

In addition to this most recent contribution of weathervision, Dage Television Division is proud that it has been privileged to fulfill a large number of military contracts. Dage TV equipment and systems include broadcast systems, microwave systems, closed circuits, color and data transmission systems, many of which are fully transistorized. More specifically, the Dage TV Division, supported by researchers, scientists and engineers, develops and manufactures TV equipment for all civilian type uses and all possible military applications.

Captain Joseph Olshefski of the 95th Fighter Interceptor Squadron holds a "weather briefing" for the members of his squadron via Weathervision, a new closed-circuit television system recently installed at the Andrews Air Force Base. He discusses the weather map shown on the television receiver in the photo simultaneously with members of his Fighter Squadron and the weather forecaster at "Operations."

LMEE puts lethal talons in the Republic F-105

LMEE armament control systems help make Republic's F-105 one of the most versatile new weapons available to Tactical Air Command in fulfilling TAC's 3-fold mission: (1) win and hold air superiority, (2) deny an enemy his reinforcements and supply, and (3) give close air support to friendly land and sea forces. ➢ ➢ In the F-105, LMEE armament control systems are integrated with LMEE flight control systems to provide increased mission capabilities and to simplify the pilot's essential duties. ➢ ➢ For brochure, write Dept. 45.

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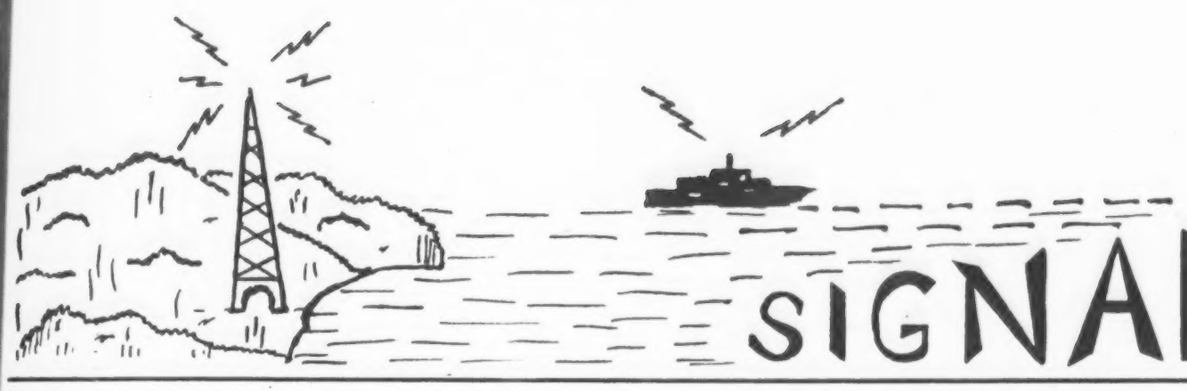
A DEPARTMENT IN THE DEFENSE ELECTRONICS DIVISION



SIGNAL·GRAM

— GOVERNMENT —

NAVY BALLOONS SCHEDULED FOR MARS According to Rear Adm. Rawson Bennett, Chief of Naval Research, two Navy balloon flights this fall should give a real clue to the possibility of life on Mars. Two scientists will ride the balloon up to 80,000 feet and use a 16-inch telescope to obtain the first clear look at Mars. The men expect to be able to measure the water vapor and oxygen content of the Martian atmosphere.

CONGRATULATIONS The U.S. Army Signal Corps will celebrate its 98th Anniversary on 21 June 1958. Chief Signal Officer Maj. Gen. James D. O'Connell has announced that anniversary celebrations will be observed on a world-wide scale by all Army Signal Corps installations and troop units with open house, demonstrations, displays and social events. Through the collective efforts of the Army Signal Corps and industry, outstanding accomplishments in research and development have been made toward the improved effectiveness of electronic, communications and photographic equipment for the Armed Services.

TOP TEN PRIME CONTRACTORS The Department of Defense has compiled a list of 404 military research and development prime contractors who received awards of $10,000 or more during fiscal year 1957. Ranking in the top ten were (in thousands of dollars): General Electric Co., $265,674; North American Aviation, Inc., $262,402; General Dynamics Corp., $211,191; Boeing Airplane Co., $150,094; Martin Co., $150,086; Douglas Aircraft Co., Inc., $116,091; Hughes Aircraft Co., Inc., $101,172; Lockheed Aircraft Corp., $91,602; Sperry Rand Corp., $87,389; Western Electric Co., Inc., $76,829.

CONTRACTS: ARMY: Kleinschmidt Laboratories, Inc., teleprinter sets and reperforators, $8,800,000; Burroughs Corp., electronic equipment and maintenance spare parts kits, $10,831,000; Fairchild Camera and Instrument Corporation, research and development for three medium-range drone photographic systems, $400,000; Gilfillan Brothers Co., missile repair parts, $719,462. NAVY: Raytheon Manufacturing Co., production of magnetron tubes, $1,125,000; Sperry Gyroscope Co., a division of Sperry Rand Corp., production of computers and related components of TALOS guided missile system, $12,821,000; Sylvania Electric Products, Inc., production of subminiature electron tubes, $1,035,000; Collins Radio Co., study of development of automatic printing telegraph system for multi-channel communication in VLF spectrum between 14 kc and 30 kc, $1,373,428. AIR FORCE: Admiral Corp., radio set controls, $1,306,237; Kellogg Switchboard & Supply Co., 400 line automatic dial telephone systems, $72,682; Convair, Division of General Dynamics Corp., test equipment, $102,716; Westinghouse Electric Corp., microwave system map, $116,308.

— INDUSTRY —

AFCEA GROUP MEMBERS AT BRUSSELS WORLD'S FAIR Electronic Associates, Inc., of Long Branch, N. J., is demonstrating their extremely versatile analog computer in the U.S. Pavilion. Westinghouse Electric International Company is featuring a two-ton giant, 26-foot "walk-in" model of a Westinghouse atomic reactor in the Atomium. The Haloid Company of Rochester, N. Y., has a fully automatic, self-operating display that will demonstrate how xerography works in the International Hall of Science solid-state physics group. (Other AFCEA group member companies exhibiting at the Fair were mentioned in the March issue of SIGNAL.)

SHARED COST PROGRAM Philco Corporation and Leeds & Northrup Company have launched a shared cost program to develop, design and build a digital computer which will have important applications in industrial process control and in scientific and engineering computation, including data processing and military applications. Development work already is under way, with field trials of a prototype computer system anticipated during 1959.

90TH BIRTHDAY OF STOCK TICKER Western Union's quotation ticker, which flashes the buying and selling prices of stocks, bonds, and commodities nation-wide from the country's principal exchanges, marked its 90th birthday in April. Transactions amounting to more than $50,000,000,000 annually are reported by Western Union tickers. Western Union tickers operate over 23 systems servicing 21 exchanges and consume nearly 1,000,000 rolls of tape each year— that's about 190,000 miles of tape, enough to make a paper ribbon that would encircle the world nearly eight times.

HALOID XEROX INC. This is the new corporate name of our group member, formerly known as the Haloid Company. The addition of XEROX to the name of this fifty-two year old Rochester firm, once wholly in the photographic-photocopy business, was made in recognition of the recent rapid growth of the xerographic phase of its business. The manufacture of XEROX products for xerography, a completely dry, high-speed copying process, was pioneered and developed by Haloid.

NEW IT&T DIVISION International Telephone and Telegraph Corp. has consolidated all of their United States research and development activities into a new division to be called IT&T Laboratories with facilities at six major locations. The new organization will handle all electronics and communications research assignments originating from IT&T's operating divisions, industry, the military services and other government agencies.

COMPUTER FIGURES INCOME TAX An electronic computer calculated and typed individual federal income tax returns in approximately five minutes per taxpayer in a recent demonstration by the Computer Division of Bendix Aviation Corporation. The individual's basic tax information including interest, dividends, contributions and medical expenses, was fed into the computer—a Bendix G-15 digital type specially "programed" for this function. Then, an automatic typewriter connected to the computer typed the return on a standard 1040 form. The taxpayer only had to add such incidental information as his address and an itemization of deductions.

NEW WESTINGHOUSE DEFENSE PRODUCTS HEADQUARTERS Westinghouse Electric Corporation has established its Defense Products Headquarters in Washington, D. C. The move of headquarters from Pittsburgh was made to facilitate Westinghouse in coordinating its full capabilities with the nation's defense program. Maj. General Boyd, a Vice President of Westinghouse, is the General Manager of the Defense Products group. He retired last fall from the USAF where he held the position of Deputy Commander for Weapon Systems at the Air Research and Development Command.

— GENERAL —

U.S. AND BRITISH MEASUREMENTS DIFFER The discrepancy of approximately one vibration per one billion vibrations exists in the radio comparison between "atomic clocks" in Great Britain and the U.S. In an attempt to settle this difference, the U.S. Army Signal Research and Development Laboratory at Ft. Monmouth, N.J., has shipped two cesium beam standards to Britain for comparison. Known as the atomichron, the atomic clock is based on the unvarying vibrations of the cesium atom and generally accepted as the most accurate standard available, having an accuracy of one second per 300 years. The clock is of tremendous importance to the Army Ballistic Missile Agency and is manufactured by the National Company, Inc., Malden, Mass.

NAME CHANGE The name of the Signal Corps Engineering Laboratory at Ft. Monmouth, N.J., has been changed to the U.S. Army Signal Research and Development Laboratory.

DEAD SEA SCROLLS The first phase of the computer analysis of the Dead Sea Scrolls has been completed, according to IBM World Trade Corporation, subsidiary of International Business Machines Corporation. The first alphabetical indexes to the three languages in which the scrolls were written (Nabataen, Aramaic and Hebrew) have been completed by using a 705 computer to transcribe the words from the scrolls onto magnetic tape for indexing of the scrolls. The compilation of the first working dictionary of the ancient vocabulary will give scholars a research tool which will be made available to several different groups.

FREE FILM AVAILABLE FROM AMPEX A new color motion-picture film, approximately 15 minutes in length and titled "Rx Ampex," contains unusual sequences of high-speed photography describing Ampex's line of magnetic tape handlers for digital computers. Prints are available by contacting Bill Fisher, Advertising Manager, Ampex Corporation, Instrumentation Division, 934 Charter St., Redwood City, California.

JULY 17-20: The 94th Infantry Division Association, Inc., is holding its 9th Annual Reunion at the Hotel Manger, Cleveland, Ohio. For further information write the Reunion Chairman, Paul R. O'Brien, 1744 Oakmont Road, So. Euclid 21, Ohio.

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STROMBERG-CARLSON

OF WHAT'S HERE AND WHAT'S COMING

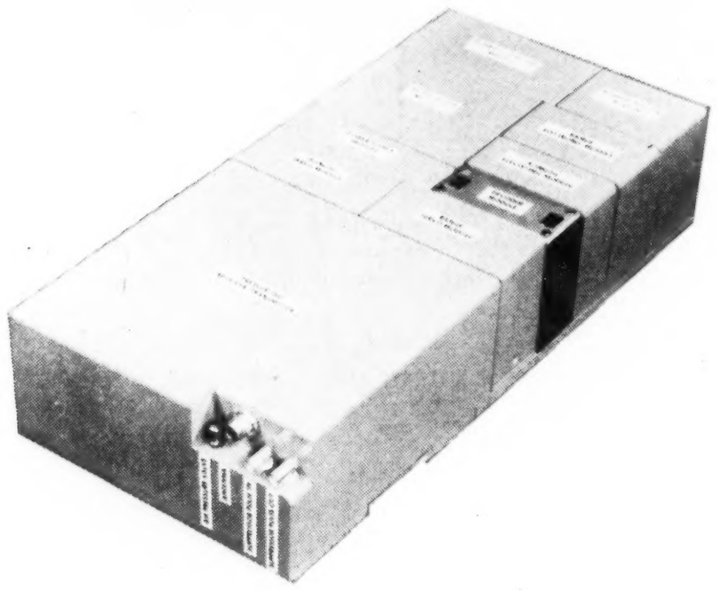
from Electronics Division, Stromberg-Carlson, A Division of General Dynamics Corporation, 1467 N. Goodman Street, Rochester 3, N. Y.

GD GENERAL DYNAMICS

THE GOOD NEW DAYS

In the field of aerial navigation, technological progress has been so rapid that much of the equipment in use only a few years ago seems rather primitive. An excellent example of the new methods of guidance is the NAVTAC system by Stromberg-Carlson.

This is our new en route navigation and instrument landing system—an integrated assembly of functional modules for modern high-performance aircraft which puts them on the correct approach and glide path and finally on the runway.



TACAN Plus

To arrive at the NAVTAC system, we started with the airborne unit of TACAN, which is familiar to you as the principal short-range navigation system, and of which we are the chief producer. To it we added a marker beacon receiver, glide slope and runway localizer for instrument landing situations.

The glide slope and runway localizer receivers operate in unison. Their channels are automatically selected in pairs via a common crystal turret containing the glide slope and localizer oscillator crystals. A common control box enables the operator to choose the desired ILS channel, while the marker beacon works independently. A new, light-weight TACAN unit provides accurate navigational information, including range and azimuth data.

The Modular Approach

We have used the modular approach in packaging the NAVTAC system. The result: you can vary the configuration of the package. I.e., the individual modules are relatively independent and can be separated up to distances of several feet without adversely affecting performance in the slightest.

Total volume of the equipment is 1155 cu. in. And if a single package happens to be the preferred configuration, the overall dimensions are 5″ x 10½″ x 22″. Weight: 47.5 lbs.

Conditions: Rugged

Of course, versatility and campactness are not enough for today's high-performance aircraft, so we planned for rugged environmental conditions, too.

Accordingly, the NAVTAC assembly has an operating ambient temperature range of —60C to +125C. And the equipment is fully efficient at extremes of altitude, too. A pressurized module for the TACAN high voltage transmitter circuits permits operation at 0 to 70,000 ft.

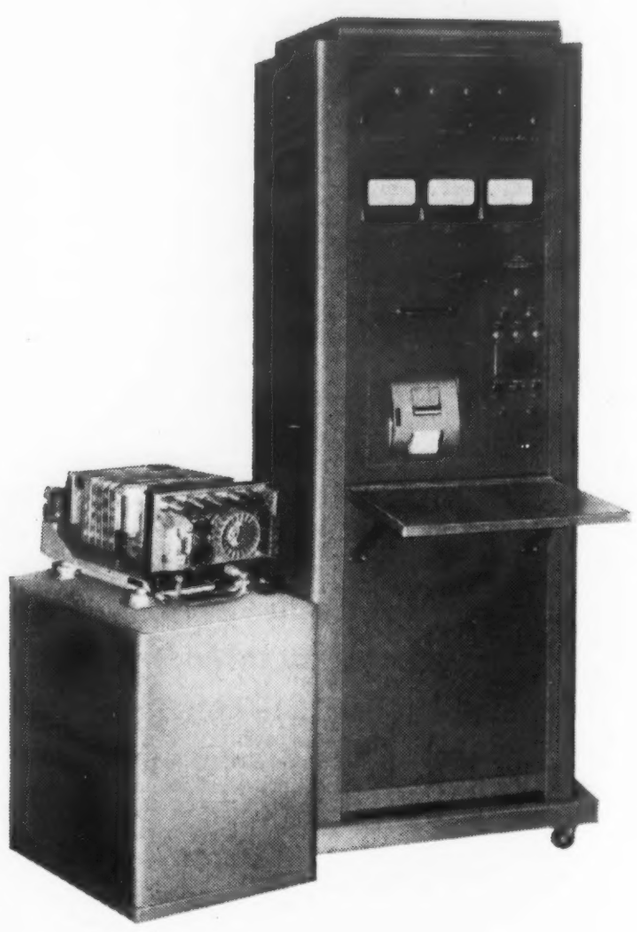
Also included in the design is the capability of performing complete pre-flight confidence tests on the equipment with the use of a small auxiliary test set. You need neither actual nor simulated beacon signals.

To sum up: we feel that the NAVTAC package contains the optimum combination of navigation and ILS equipment for the high-performance aircraft (military and civilian) which will be operational in the coming decade.

RAMIFICATIONS

Ever since 1953, when we first entered the TACAN field, we have found our activities here expanding to huge proportions. This situation has of necessity taken us into related fields, of which test equipment is an excellent example.

We recognized early the need for automatic test



devices to reduce the test time required by equipment as sophisticated as the ARN-21 airborne TACAN unit.

Covering All Bases

First, we designed and developed the TACAN Automatic Acceptance Tester. This cycles TACAN through tests on all 126 RF channels for automatic testing of:

1. Transmitter center frequency. This test verifies the correct placement of crystals in the turret assembly.
2. Transmitter power output. This test determines whether the second pulse of an output pair is 1 kw peak or more.
3. Receiver sensitivity. Here we determine whether the receiver will function properly at an input signal level of —76 dbm.

Space permits only a mention of other automatic test devices, namely: 1000mc beacon simulator, ramp test set (for flight line testing of TACAN-equipped aircraft), and 1000mc peak power test set.

All the above are items which we are currently producing or can furnish on short notice.

NEW DATA LINK

We've developed a new data link—full name: Light Aircraft Binary Information Link, generally designated by its initials as LABIL.

The LABIL Data Link provides rapid automatic transmission of flight information from light aircraft to central ground receiving and control locations. Data entered into the link by the aircraft pilot or observer is transmitted automatically on demand from the ground through the voice channel of *existing communications equipment.*

The ground-based data checking and printing equipment is fed directly from the communications equipment audio output. Reliability in printed data is of the highest order, and speed of transmission is limited only by the bandwidth of the accompanying communications equipment and/or print-out device.

On Land, Too

While LABIL is designed specifically for light aircraft application, the small size, light weight and low power drain of the airborne unit—plus the fact that the basic form of the data transmitted is quite general (arbitrary letters and figures)—make the equipment equally applicable to any other situation where data reports from mobile remote locations must be made quickly and reliably. Tanks and observation vehicles are typical examples.

If you'd like more details on any of the above matters, *or if you have a problem you'd like us to tackle,* please let us hear from you. Write to Military Marketing Dept. at the address on the masthead.

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GD GENERAL DYNAMICS

Electronic and communication products for home, industry and defense

part I

electronics in the coast and geodetic survey

REAR ADMIRAL H. ARNOLD KARO, USC&GS

DIRECTOR, COAST AND GEODETIC SURVEY

THE MODERN ERA OF ELECTRONICS has brought with it major changes in surveying and mapping methods. The great strides achieved in the advancement of science and engineering during the two World Wars have given the surveyor and mapmaker new tools. Significant among these is the utilization of the velocity of propagation of sound and electro-magnetic waves. Measuring distances, either vertical or horizontal, by electronics is simply the accurate timing of these waves. Despite their great speed, this is possible with varying degrees of accuracy from the less rigid requirements of navigation to the precision required in geodetic surveying.

The Coast and Geodetic Survey of the United States Department of Commerce pioneered in the use of electronics in echo-sounding and radio acoustic ranging (RAR). These were the first practical applications of subaqueous acoustics and radio signals in navigation and surveying. The development of both these early electronic devices was stimulated through intensive experimentation following the sinking of the *Titanic* in April 1912 by collision with an iceberg. Attempts to obtain echoes from the submerged portions of icebergs led to the development of unique equipment whose ultimate usefulness was not that for which it was originally intended.

World War I gave impetus to intensive experimentation and development of underwater sound generation and receiving techniques. Leading scientists and engineers devoted considerable time and energy to submarine signaling devices and numerous other underwater sound aids to navigation. The Coast and Geodetic Survey provided leadership in these first applications of electronics to surveying and navigation through the efforts of Dr. Herbert Grove Dorsey, who, in 1923, developed a visual-indicating device for measuring extremely short time intervals by which depths of both shoal and deep water could be registered automatically. This method of registration is still employed in most of the echo-sounding instruments in use today.

The first echo-sounding instrument used by the Coast and Geodetic Survey in 1923 was known as the Sonic Depth Finder.

The Sonic Depth Finder transmitted a sound in the water at the precise instant the echo from a previously transmitted signal was heard. The operator used a set of headphones through which he could hear the transmitted signal through one ear and the echo through the other. By a variable-speed mechanism the operator could vary the interval between transmitted sound signals until the transmitted sound and the echo were heard simultaneously. The position of the dial on the variable-control mechanism served to indicate the depth. Although the Sonic Depth Finder was far superior to earlier sounding instruments, it had numerous shortcomings as a hydrographic survey instrument.

Adm. Karo's article will appear in two installments. Part II will be published in the July issue of SIGNAL.

Director of the Coast and Geodetic Survey since August 1955, Adm. Karo is a 1923 graduate of the University of Nebraska and has had 34 years of service with the Bureau, including command of its largest ships. During WW II, he served with the U.S.A. Air Force and as Commanding Officer of the Aeronautical Chart Plant, St. Louis, Mo. Preceding his recent promotion to Director, he was Chief of the Div. of Charts in Washington. Adm. Karo is a member of the Society of American Military Engineers, the U. S. Naval Institute, the American Congress on Surveying and Mapping, and is a graduate of the Industrial College of the Armed Forces.

In due time, through intensive research and development, a commercial instrument was designed and built by the Submarine Signal Company. It eliminated most of the objectionable features of the Sonic Depth Finder and was installed on all ships of the Coast and Geodetic Survey to supersede the previously used equipment.

Echo-sounding was a much faster, more accurate, and easier method of hydrographic surveying than any method previously used. However, most of the instruments available in the United States prior to 1935 were designed for use on commercial vessels and, while sufficiently accurate for navigation, they did not fully meet the requirements of the hydrographer.

A precision instrument was needed with which soundings between a few feet and 20 fathoms could be obtained with far greater accuracy than with any existing instrument. The design of such an instrument was started in 1933 in the Washington laboratory of the Coast and Geodetic Survey. This entirely new instrument, known as the Dorsey Fathometer No. 1, was installed on the *Lydonia* in 1934. Using a sound frequency very close to supersonic, it was the first attempt by the Coast and Geodetic Survey to employ higher-frequency sound waves in echo-sounding. Several years later further improvements were made on two instruments of this type which were installed on the *Oceanographer* and the *Hydrographer*.

The Dorsey fathometer was the last visual-type echo-sounder to be used by the Coast Survey. Experiments made with recording echo-sounders demonstrated their superiority for hydrographic surveys. The recording instrument provides a permanent sounding record subject to review at any time after the survey. It also reveals additional submarine features such as substance and other geological characteristics of the bottom.

Specifications for a recording instrument were prepared by engineers of the Survey from which a commercially built instrument was developed known as the 808 echo-sounder. Used almost exclusively for the past eighteen years, the 808 echo-sounder is powered from a twelve-volt battery and requires about twelve to fifteen amperes for operation. Soundings may be in either feet or fathoms, with the full depth range of 160 feet or fathoms which are divided into four 55 feet or fathom scales with overlap between scales, thus giving an expanded record, resulting in better bottom detail.

RADIO ACOUSTIC RANGING

The submarine menace of the first World War created an urgent need of a practical method of detection. This led to intensive study of the transmission of sound through sea water as a solution to the problem.

In the postwar period, the War Department continued studies involving transmission, reception and velocity of underwater sound employing small bombs suspended below targets whose positions were to be determined. The arrival times of the sound waves resulting from the explosion of these bombs were recorded at short stations connected by cable to submerged hydrophones at various distances from the source. The results obtained encouraged the Coast and Geodetic Survey to modify the method for control of hydrographic surveys.

These experiments resulted in the development of radio acoustic ranging (RAR). See Figure 1. This greatly improved method of control of hydrographic surveys made possible the accurate determination of the position of the survey vessel by the indirect measurement of two or more distances. The distances were derived from the accurate measurement of the time required for a subaqueous sound, originating at a selected position, to reach two or more suitably located receiving units whose geographic positions were known. The distance from the source of sound to each receiving unit was determined by measuring this travel time and multiplying it by the effective velocity of sound. Knowing the distances to two or more receiving units, the position of the survey vessel could be located on the survey sheet

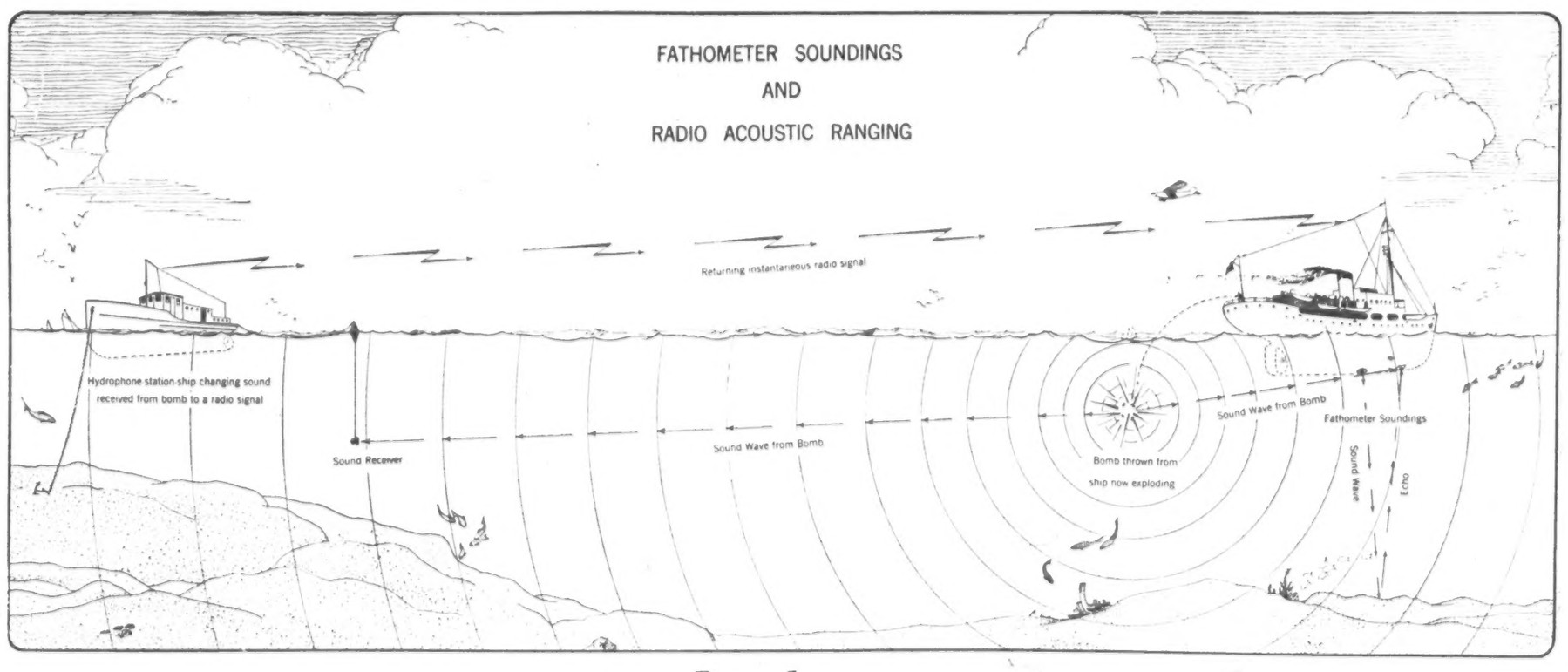

Figure 1

at the intersection of arcs constructed with these distances as radii.

This method provided a means of carrying surveys far beyond the horizon, and it promised the additional advantage of not being restricted to daylight or clear weather operation. By present-day standards this method would be considered crude and inadequate, but at the time it was used no other system existed which could compete in range and accuracy with RAR.

When surveying with RAR, the hydrographic vessel steamed along on a sounding line, and at fixed intervals dropped a small fuse-ignited bomb over the side. The sound of the explosion was picked up by a hydrophone in the ship, which initiated the zero time mark on a chronograph tape. The sound of the explosion traveled in all directions and upon arrival at a pre-established RAR station it was detected by hydrophones and amplified sufficiently to trigger a radio transmitter. The activated receiving units automatically transmitted the radio signals from the RAR station to the vessel, where they were picked up and recorded on the same tape with the explosion. The travel times to the respective receiving units were then scaled from the chronograph tape and converted into distances by applying the proper velocity factor. Knowing the positions of appropriately located receiving units, the position of the vessel could be determined from two or more RAR stations.

In areas which are characterized by deep water close to the shore, long ranges of 75 to 100 miles were not unusual. In regions noted for large areas of shoal water, the explosive sound was considerably attenuated before reaching the RAR station hydrophones when in shallow water just off the beach. It was necessary to use small vessels in such areas called "Station Ships," anchored well off shore in the more favorable deep water. The hydrophone was suspended over the side or buoyed from the vessel, but in all other ways functioned as the shore-based station.

To eliminate the need of station ships, the Coast and Geodetic Survey undertook a development program to design an unattended floating RAR station. The cumulus of this program was a buoy station containing an acoustic amplifier trigger circuit and transmitter. An antenna projected above the buoy, and the hydrophone was suspended a few fathoms beneath. Capable of 20 to 30 days continuous operation, this device, which became known as the "Radio-Sono-Buoy," represented considerable savings in the cost of a survey. During World War II these Radio-Sono-Buoys became useful in anti-submarine warfare. See Figure 2.

With the beginning of World War II, all RAR surveys were stopped, and were not resumed. While RAR was a tremendous advance in offshore surveys, it was far from satisfactory in many important aspects. Studies revealed that its continuance would be as expensive as the surveys that RAR was expected to produce. These cost factors and the development of electronic positioning equipment led to the abandonment of RAR.

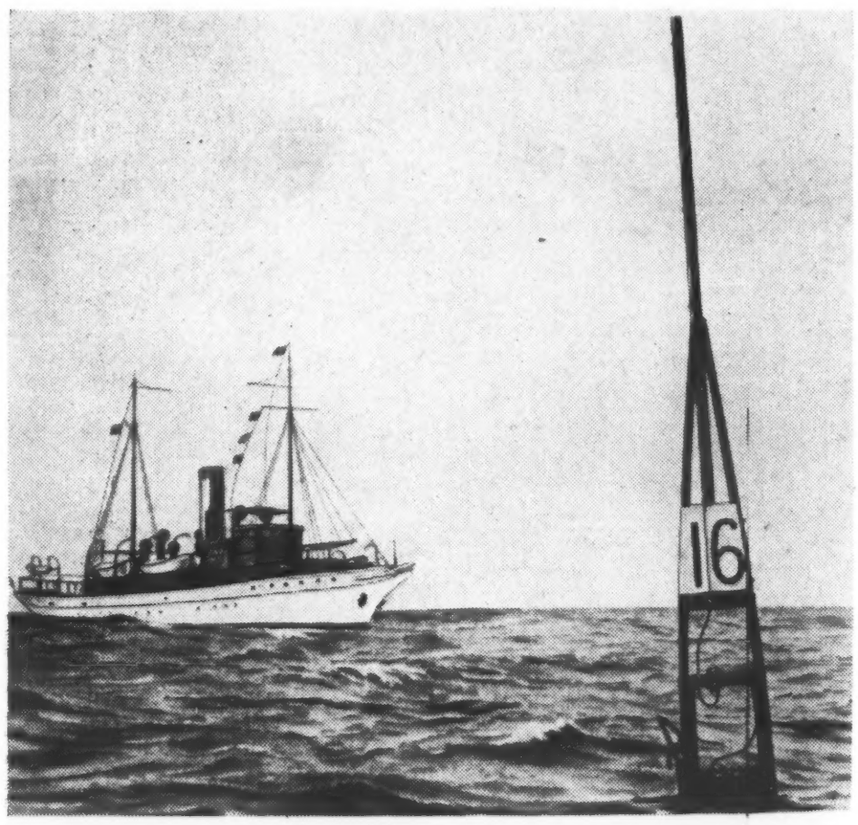

Figure 2

ELECTRONICS IN NAVIGATION

By the termination of the war, the Coast and Geodetic Survey had plans based on developments in electronic navigation and instrumentation resulting from the war program. While there were numerous navigation systems, few could entirely meet survey requirements as to range and accuracy, and many had to be discarded for other reasons. For surveys far off shore there was no system that could comply with requirements for a modern survey. However, for surveys closer to the shore there were certain radar-transponder devices suitable for well controlled hydrographic surveys. Among these systems, Shoran, a precise bombing device, seemed to have the most favorable characteristics. Shoran proved to be a good selection and the system is still used extensively by the Coast and Geodetic Survey.

Shoran: This method was developed as a means of navigating the airplane for air photo reconnaissance, and was later applied to precise bombing. An interrogator is carried in the plane which positions the plane with respect to two separated ground-referenced transponders. Originally designed for air-to-ground navigation, the adaptation of this system for sea-to-ground navigation was not a matter of simply placing the interrogator on a ship and the transponders on the beach.

The range of operation is generally limited by the height of the ship and ground station antennas. Since the interrogator antenna is seldom higher than 80 feet and the transponder antenna is no higher than 500 feet, the maximum average range is limited to between 40 and 60 miles. The principal factor requiring intensive development involved the instrumental error which results from the variation in the reception of signal intensity. This error is also a function of distance and related to changes in propagation characteristics. With accountability made for this error, Shoran has proven satisfactory in most respects as an inshore survey system.

Loran: In attempting to extend the range of accurate control for offshore hydrography, consideration was given to Loran, one of the major war-developed systems for long-range navigation. Even though the range is sufficient there are, however, certain other features which have prevented its use for accurate control of surveys. Some of these are: (1) the diminishing accuracy encountered in proportion to the increase in distance from the ground station base line; (2) that Loran coverage is not sufficient in all survey areas; (3) the expense of establishing three ground stations in survey areas, and (4) the difficulty of drawing the hyperbolic grids for the survey sheets. While Loran, as a system, is not suitable for surveys, many of its operating principles, combined with other techniques, have been applied in such a way as to remove some of the objectionable features of this long-range navigational system.

Electronic Position Indicator: As stated earlier, war-time electronic developments had not produced a navigational system considered adequate for offshore surveys. The Electronics Laboratory of the Coast and Geodetic Survey made a basic engineering study of this problem, resulting in the design of the Electronic Position Indicator (EPI), a system which most nearly meets offshore requirements. The entire development program was done in the Washington laboratory, and field tests were made on board a survey vessel assigned for this purpose.

The EPI system combines some of the features of both Shoran and Loran. Basically, the distance measuring methods are the same as Shoran. A transmitter on the survey ship sends out radio frequency pulses which arrive at the ground stations whose transmitters operate on the same frequency and are synchronously locked to these ship signals. The time for the ship signal to reach the ground station and for the ground station signal to return to the ship is governed by the distance between the ship and the ground sta-

(*Continued on page* 49)

COMMUNICATION

A rugged vehicular radio, with greater range, for army tactical teams

To fulfill this requirement, Collins designed the AN/GRC-19. Mounted in jeeps and trucks, it takes parachute drops in stride, performs more functions than a combination of its predecessors. The GRC-19 gives instantaneous communication to army units parachuting deep inside enemy territory, or moving 40 to 50 miles apart. As much as four times the power of earlier radios and a wide range of medium and high frequencies are provided by the GRC-19. Under the multiple source production program, contracts have also been awarded to other companies; however, the GRC-19 is an exclusive Collins development in conjunction with the U.S. Army Signal Corps Engineering Laboratories.

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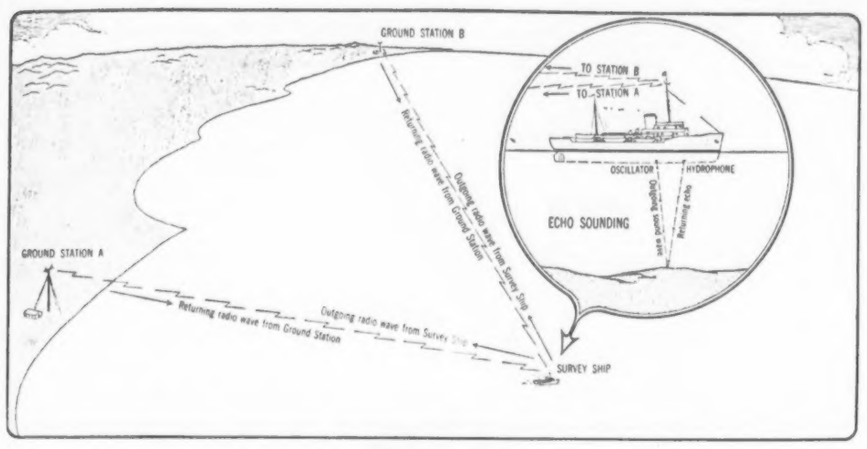

Figure 3

tion and velocity of propagation. Distances to both ground stations are measured simultaneously on the ship. See Figure 3.

The entire system operates on a single frequency, in the range between 1800 and 2000 kilocycles. Long-range operation is made possible by the use of these frequencies, as the signals follow the curvature of the earth and are not line-of-sight, as are Shoran and other VHF systems. Ranges over 500 miles have been measured with EPI, but more consistent results are obtained for distances between 300 and 400 miles. The minimum practical range is about 14 miles from the ground station; however, distances as short as about 7 miles have been accurately measured. Average range accuracy to each ground station is about 75 yards.

For the average survey, the ground stations are close to the beach, with the two stations usually spaced about 100 to 300 miles apart. Two or three days are required to establish a station, which consists mainly of a 100-foot tower, a radial ground plane, and an instrument shelter located about 100 feet from the antenna. A pair of ground stations may be used for many months of survey operations, and in some regions, such as Alaska, the stations are kept manned and stocked for long periods of operation without resupply.

While the EPI system has some undesirable features, it still remains the primary method used by the Coast and Geodetic Survey for offshore navigation, as no other system affords the same combination of range, accuracy and mobility. Continual studies are being made to improve EPI, but due consideration is also being given to the development and application of other promising long-range navigational systems.

ELECTRONICS LABORATORY

For over thirty years the Survey has maintained an Electronics Laboratory in Washington to work on its many electronic problems. The very earliest function of this laboratory was to maintain the communication and echo-sounding equipment used on the hydrographic ships operated by the Bureau. Progressive experimentation and refinement in improving the basic design of electronic devices, principally in the field of echo-sounding, have been made the responsibility of the laboratory.

For many years members of the Electronics Laboratory staff have been considered authorities in the fields of precise echo-sounding and marine navigation employing electronics. The EPI system was developed by the laboratory staff, as well as the many tests required for the adaptation of Shoran as a hydrographic instrument. The accumulation of years of experience in echo-sounding has been applied to the development of various echo-sounding surveying instruments. Some of these instruments have been constructed in the laboratory as prototypes; others have been constructed by commercial manufacturers in accordance with Bureau specifications.

In addition to hydrographic surveys, electronics has also been used effectively in other survey activities of the Bureau. Since it was apparent that there were many ways in which the Electronics Laboratory could assist in other phases of Bureau activities, its responsibilities were expanded to include them, and the scope of the laboratory now includes electronics problems related to tides and currents, geodetic measurements, seismological investigations and geomagnetic studies. The electronic application of these subjects will be discussed in the July issue.

Bruton (*Continued from page* 27)

sage), would build a stack several feet high.

Ways and means to handle the volume today include increased multiplexing (we will have as many as 16 RATT channels on some of our point-to-point SSB circuits), increased teletypewriter speed, increased use of data, and high-speed automatic crypto.

Of course, one of our continuing problems is to maintain and improve the *security* of our communications.

Imagine, in a space considerably smaller than a football field, as many as a dozen high-power search, gunfire and missile control radars, multiple radio communications equipments covering all frequencies from LF up, TACAN and LORAN, with antennas sometimes as close together as a few feet, with other large conductive structures in the same area—imagine most or all of these equipments operating at the same time; then you can appreciate the electronic compatibility and interference problem of a naval warship!

When *some* new equipments are installed we get the interference down to a workable, acceptable level by the use of shielding, bonding, filtering, relocation of equipment and antennas, and other means. Of course, much can be and is being done to "clean up" the radiating equipment in design and construction, and to improve selectivity of receivers. I am sure you recognize that shipboard electronic environment always presents a challenge.

We have, in addition to the electronic compatibility aspect, one of space, weight and, particularly, antenna. Space and weight problems progressively are being solved by the new well-designed, compact, sometimes transistorized equipments, for we run into difficult cooling situations on board ship just as we do in aircraft.

Shipboard antennas have always caused trouble since they had to be located clear of arcs of gunfire and lifting booms and because they were adversely affected by other conductors in the vicinity. Consequently, our shipboard antennas have been very poor. By constant education, we now have received recognition of the importance and magnitude of our problem, and antenna location and design are being given careful consideration in ship alterations and new construction. We naval communicators consider this a major victory.

The shipboard communications problem varies with the type. The submarine's problem is the worst, and the aircraft carrier (because of the conflict between antenna location and flight operations) is almost the same.

Our biggest problem is communications personnel turnover, which we hope the current Cordiner pay legislation now under consideration will help to cure.

We have made the radioman schools more attractive by increased emphasis on instruction in maintenance and electronics. We recently have re-established a highly desirable, six-month advanced course for career radiomen. And we now have at the Navy Post Graduate School, Monterey, California, a new 2-year officer course in communications engineering, leading to a degree.

In the solution of our problems, we continue to receive much assistance and cooperation from our sister Services. We in the military communication-electronics business have common interests and understanding which promote unification in the true meaning of the word.

① FEDERAL TELECOMMUNICATION LABORATORIES
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Largest laboratory unit of the IT&T System and one of the nation's most important centers of electronic research and development . . . noted for its pioneering in air navigation, missile guidance systems, communications, and other fields.

② FEDERAL TELEPHONE AND RADIO COMPANY
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In its million-square-foot plant, Federal offers every facility for producing a wide range of electronic systems and equipments for air navigation and military use, including Tacan, Vortac, ILS, ATC transponders, Data Link (Vortac); also missile guidance and command systems, Data Link (missiles), automatic check-out and ground test equipment, and electronic countermeasures.

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Specializes in the development and manufacture of electrical and electronic components for radio and television manufacturers, government, industry, and distributors, with Federal products in such fields as selenium and silicon rectifiers, hermetic seals, tantalum capacitors, power tubes, traveling wave tubes, and *Kuthe* hydrogen thyratrons.

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Producer of aircraft and missile power supplies; closed-circuit TV, infra-red viewing, mobile radio, and transistorized equipment; analog-to-digital converters. Supplies a full line of measuring and testing instruments.

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IT&T System's principal field engineering service, training, installation, operation, and maintenance organization, providing skilled engineers and technicians for posts throughout the world. Operates DEW Line and White Alice networks for the United States Air Force.

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THE STRUCTURAL ART OF RADIO TELESCOPES

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RADIO ASTRONOMY HAS captured the popular imagination. People are interested in everything pertaining to outer space and cosmology with an intensity similar to their interest in westward expansion a hundred years ago.

Radio astronomy has opened a window into the void several times wider than the one covered by optics, and it promises to see farther into space than the conventional telescope. These are exciting possibilities to the astronomer. At D. S. Kennedy & Co., where most of the radio telescopes used in this country have been built, we have been amazed at the degree of public interest. The bombardment of requests for material and models for science fairs has been terrific (resulting from innumerable popular articles and TV shows prepared about radio astronomy). We have seen the radio telescope used as backdrops in national advertising along with missiles and great dams and other tremendous engineering feats. We have been interested in discovering the reason for the general excitement.

For one thing, the radio telescope is as photogenic as Hollywood cheesecake. Anyone who has been privileged to experience a close approach to one of these structural fantasies has been impressed with a feeling of graceful grandeur. Photography catches some of this rhythm of form, and photographs of radio telescopes have been eye-catching subjects for many news stories. We have come to the conclusion that the structure of these devices has as much to do with their appeal as anything else.

This leads us to think that the structural art back of radio telescopes is almost as important as the scientific promise, for the structural progress being pushed by giant instrumentation will find ready application to many other fields of electronics. In basic research we recognize the importance of the principle of serendipity, the discovery of one new fact when we are really looking for another. No one knows at what moment a fact discovered in some odd-ball pursuit of knowledge will become a key to a great scientific advance. Radio astronomy will no doubt produce many examples of this kind of scientific progress. But many of us probably do not equally realize the importance of a similar principle of progress in the technical arts.

Radio astronomy has been pushing forward the state of electronic structures because radio telescopes must be huge. Except for the immense atom smashers, such as the proton synchroton at Brookhaven National Laboratory, scientific instrumentation nowhere approaches the structural magnificence of the radio telescope. The radio telescope must be a hundred million times more sensitive than a television receiver, and this means first of all an instrument of giant size.

In fact, radio telescopes will become larger and larger because the science of radio astronomy is at present not much more advanced than optical astronomy was at the time of Galileo. As the optical astronomer after Galileo sought for greater light gathering power, or larger glass lenses, so today's radio astronomer seeks for larger radio lenses. In electronics we recognize this as the search for antennas of larger and larger aperture.

Upon the dimension of the aperture depends the telescope's resolving power, its detecting power, and, ultimately, the total number of radio sources it can see. We humans without the aid of a telescope can see about 5,000 stars. Due to the much longer length of radio waves as compared with light waves, the antenna aperture must be very large just to allow the radio telescope to see only as many objects as the human eye. In order to detect a million objects radio telescopes will need apertures of 25 to 50 acres.

Radio astronomers have used many ingenious antennas and arrays, but the most sophisticated type is the paraboloid with a collector at the focal point. The past five years have been marked by the growing realization of the importance of radio astronomy and the consequent willingness to spend money for large paraboloids. The most famous of these, of course, is the altazimuth mounted 250-footer at Jodrell Bank in England. Two other famous ones have recently been completed in this country, the George Agazzis 60-foot telescope for Harvard and the 84-foot one at Riverside, Maryland, for Naval Research Laboratory. Both of these are Kennedy-built equatorially mounted paraboloids. The most pre-

(*Continued on page 54*)

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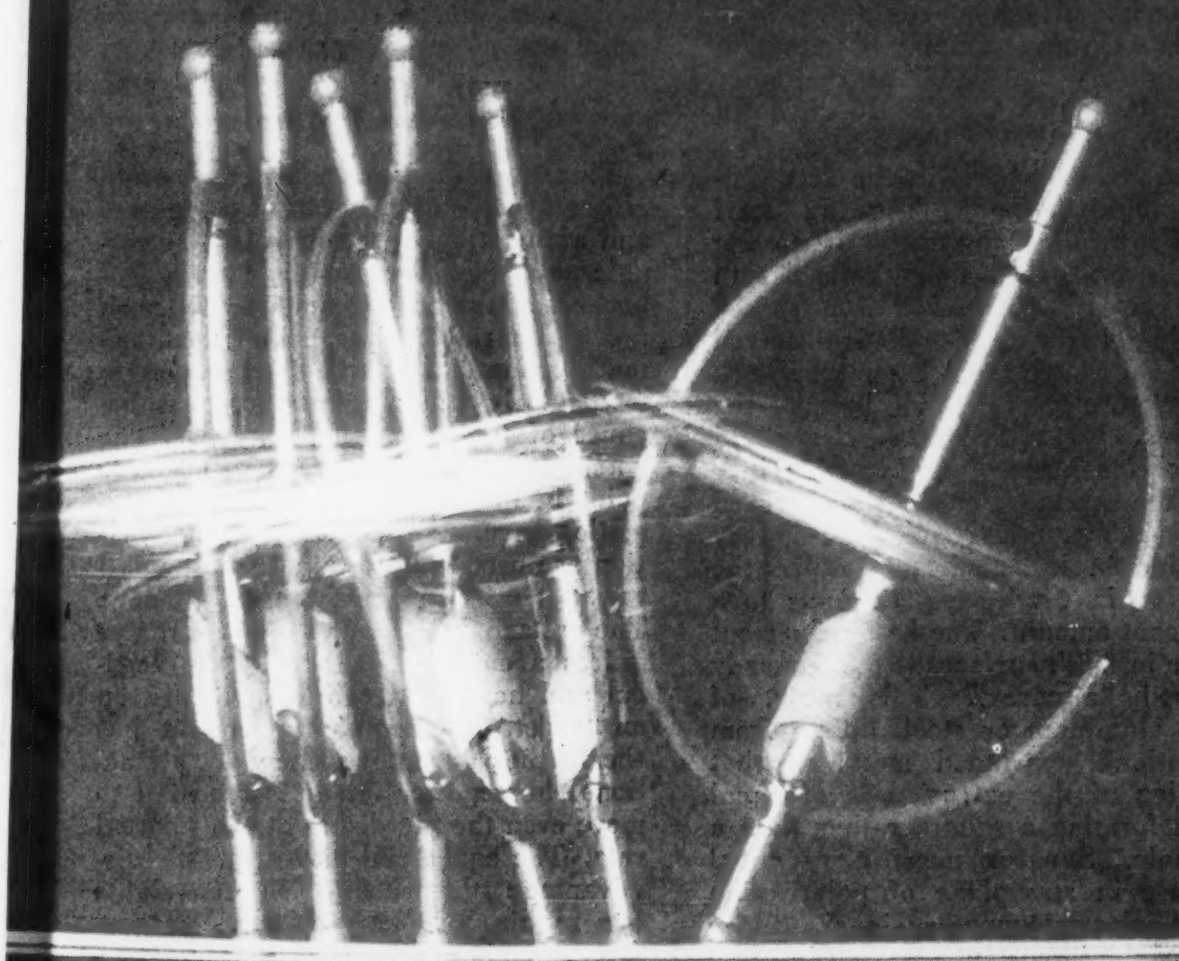

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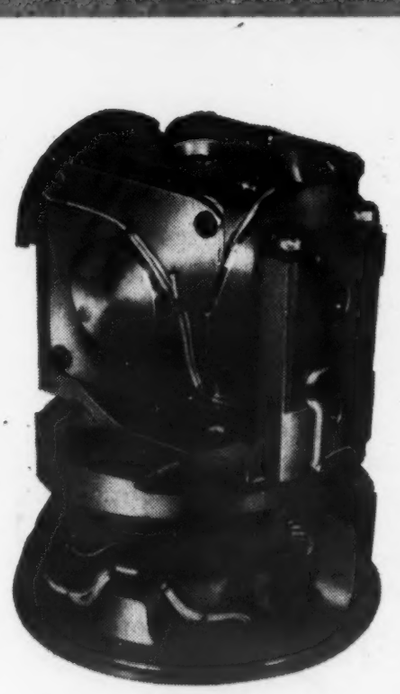

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tentious telescope presently under way in this country is the 140-foot equatorial mount being sponsored by the National Research Foundation for the National Radio Observatory at Green Bank, West Virginia. The next project the radio astronomers are dreaming about is a steerable mount with a reflector between 600 and 3000 feet in diameter. The larger dimension, if achieved, will perhaps reveal as many as 10 million radio sources.

The first influence radio astronomy will have, therefore, is upon the size of electronic structures.

A second influence is upon the accuracy of the reflecting surface. A perfect parabola would concentrate every ray of energy upon the focal point. The allowable tolerance of the surface is arrived at by computing the loss as a function of wavelength. The allowance figure is generally taken to be from 1/10 to 1/16 wavelength. Probably the most important frequency in the radio spectrum is the hydrogen line at 1420 mc or 21 centimeters. At this frequency the permissible variation of any point on the reflecting surface would be in the order of ½ inch. It is significant to note, however, that the aim for the 140-foot telescope at the National Radio Astronomy Observatory is for a tolerance of ¼ inch! This is comparable to machining a one-inch piece to about four thousandths tolerance. While modern machine tools have no difficulty in cutting to this tolerance, a similar degree of accuracy in large surfaces would be an outstanding achievement in modern technology.

Environmental Effects

Very closely associated with the surface accuracy is surface loading. All radio telescopes are exposed to the natural ambient environment of all outdoors. No type of housing yet proposed promises to be suitable. Weather, particularly the wind, generates stresses that tend to bend the surface. If the instrument is to have any practical value the surface tolerance must be maintained even though operating in the prevailing winds of the area. The Green Bank 140-footer is expected to maintain its tolerance in 16 mph winds. Tolerance under stress is maintained by increasing the trusswork support of the surface. But of course, additional weight in the trusswork tends to increase the distortion due to gravity. A steerable antenna introduces other interesting distortions in that the configuration of the force of gravity changes with the attitude of the antenna. Truly, the creation and maintenance of a supra-accurate surface is an interesting challenge to modern technology.

Illumination of the antenna is one of the design aspects that requires much attention in the construction of radio telescopes. Even though great care is taken to maintain a close surface tolerance, this effort will be wasted unless equal care is exercised in achieving proper illumination. For this design aspect we generally think of the problem from the point of view of the antenna as a radiator, although what the antenna sees as a passive receptor has the same configuration. As a radiator, the primary feed at the focal point of the parabola emits a beam with sloping sides. If the primary feed is designed to encompass the entire antenna surface, the energy level at the outer edge is so low that the outer reaches of the antennas are essentially wasted. We might as well have made a smaller antenna and saved our money. On the other hand, if the beam is made so wide as to flood the surface with a uniform intensity the sloping sides of the beam would spill over the edge and be wasted. Antenna engineers have settled on an optimum illumination which allows the signal at the outer edge of the antenna to be 10 db down from the center.

Grote Reber, who built the first genuine radio telescope following Karl Jansky's original discovery of cosmic static in 1932, used a parabolic design with sheets of galvanized iron as the reflecting surface. He had observed that his feelings about a wire network surface were not favorable because the need for several hundred dipoles would make the task very complicated. Since that time the mesh surface has proved to be quite practical and, indeed, very desirable in large surfaces, since the reduction in wind stress amounts to a significant amount. The best refinement to date in mesh surfaces is the Kennedy designed "Squarex." This mesh, of either aluminum or steel, differs from conventional expanded metal in that each leg of the extrusion is of equal length forming a square rather than a rectangle. Squarex mesh gives equal response in any plane of polarization of an electromagnetic signal. Since some of the important research in radio astronomy involves work on the polarization of celestial signals, surface material of this type is quite important in the construction of radio telescopes.

Turning now to the electronic portion of the radio telescope it seems evident that radio astronomy is sure to have a very marked influence upon the sensitivity of receivers. Basically what a radio telescope undertakes to do is to measure the characteristics of electrical noise originating in outer space. Hence, any noise of terrestrial origin reduces the maximum sensitivity of the instrument. Everyone concerned with electronics knows that the noise of components associated with the first stage of the receiver limits its ultimate sensitivity. Therefore, radio astronomy will tend to push the development of noiseless receivers to the limit.

Work on the crystal mixer of conventional superhetrodyne receivers promises to lead eventually to circuits that will be limited mainly by antenna noise. Another device, the maser, is being adapted for use in radio astronomy. The word "maser" stands for "microwave amplification by stimulated emission of radiation," and the descriptive phrase tells pretty much how it operates. When stimulated under the proper conditions by, say, one unit of radiation, a material in the maser emits radiation of much greater amount. One of the "proper conditions" is to keep the maser at the extremely low temperature of liquid helium. The maser would need to be installed at the focal point of the paraboloid like a probe. One of the developmental problems is the fact that, with the refrigeration equipment required, the maser is so bulky as to cause undue aperture obstruction. Harvard University has a maser under development for use on their 60-foot telescope. Development of the maser means the same to radio astronomy as the development of improved photographic emulsions meant to optical astronomy.

Curious Anomaly

Finally, radio astronomy will probably affect the application of computers and automation to the driving of steerable antennas. We can say "probably" because of the curious anomaly between the equatorial mount and the altazimuth mount. An equatorial mount is particularly suitable for telescopes because of the simplicity involved. The antenna lens points always to a single point in the heaven when set on automatic drive. Adjustments in declination are used only to take care of small variations in the position of planets. The altazimuth mount, however, requires a constant change in the vertical and horizontal coordinates to keep on target. The equatorial mount has the further advantage that only a fractional horsepower motor is required to move even the big dishes at the sidereal rate. The equatorial mount has the disadvantage that heavy counterweights are required to give balance. Therefore, at about 100 feet the counterweights begin to get out of hand, and by 200 feet the equatorial mount begins to be out of the question if reasonable sky coverage is to be achieved. As the steerable paraboloid increases in size the altazimuth or other type of mount becomes likewise a virtual necessity.

With any mount other than the equatorial, programed computer tracking becomes likewise a virtual necessity.

What, then, are some of the implications of radio telescopes for the general field of electronics? What improvements are to be expected because of the advances in the structural art that led to the huge radio telescope? While we should not credit radio astronomy for making progress possible, we can note how practice in the structural art of radio telescopes has carried over into structures for other areas of electronics.

For example, concomitant with the development of increased size in radio telescopes, antenna designers were increasing the size of parabolic dishes used for the communication system called "tropospheric scatter propagation." Tropo scatter has made rapid strides, promising now to link the en-

tire globe with multichannel voice communication that has better than 99% reliability. Tropo scatter links, using 120-foot paraboloids, are already spanning 700-mile gaps. This new communications system, having the reliability of the telephone line, is installed without laying cable. Hence, it is especially suited to spanning impassable terrain and large stretches of water. But areas where these conditions prevail are regions of the world's worst weather. Maintenance of surface accuracy in these regions becomes a difficult problem because winds and ice loads impose a tremendous bending stress. For example. the 120-foot antennas mentioned above must keep accuracy of surface close enough to permit continued operation even though undergoing winds to 180 mph when loaded with 12 inches of ice. While radio telescopes are never expected to operate under such conditions, we see that scatter communications antennas are extensions of the structural art of the telescope's large, accurate parabolic surface.

Long distance has been making the news in recent months. We have read about radars with ranges of 100 miles. We are told that ranges to 3000 miles are possible. The radars now operating are using antennas of 84 feet, 120 feet and larger, all based on the large, accurate paraboloidal surface.

A third area of the large antenna is in missile tracking. Antenna systems, very similar to radio telescopes except for the use of altazimuth mount instead of equatorial mount, are used to track missiles and satellites on the Cape Canaveral test range. These antenna systems, using telemetry circuits, are automatic trackers.

While none of these electronic systems would ever have been possible except for the giant antenna, we should not overlook the increased transmitter power and receiver sensitivity developed during the same period. The value of increased receiver sensitivity is especially apparent to military men. The ultimate limit in noise level is set by static of the heavens. If we could design a receiver with a noise level so low that only the signals of interest to the radio astronomer affected the sensitivity, we would be able to receive over much greater distance or operate at much lower power. At present the capacity of the large antennas is beyond the sensitivity level of the receiver. When receivers are developed that hear almost nothing but cosmic noise, military electronics can take a big step forward.

Radio astronomy has been accompanied by three important achievements: extraordinary size of antenna aperture, great precision in antenna surface accuracy and improved receiver gain. Radio astronomers are talking about steerable antennas of 3000 feet in diameter. We are not even able to guess at the electronic advances coming when progress in the structural art allows such antennas to be achieved.

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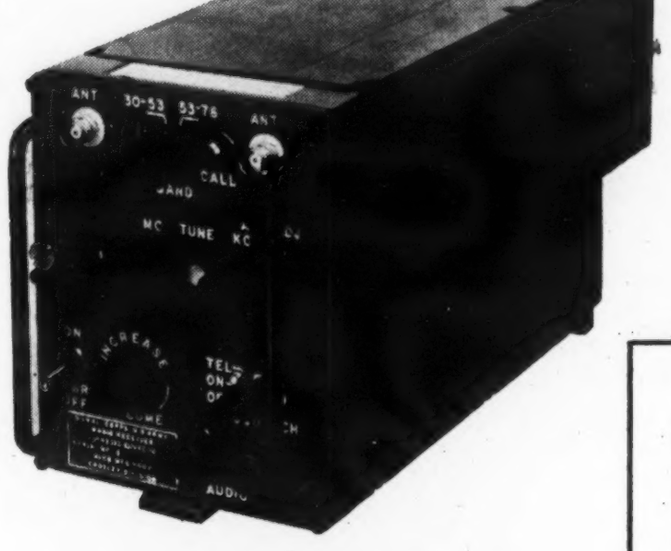

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I WISH TO BRING YOU THE GREETINGS OF MY COUNTRYMEN who owe so much to America. At the National Military Industrial Conference in Chicago in February I recognized several American soldiers and officers whom I met some 12 years ago on the battlefield of Europe. It moved me deeply to meet them again at an occasion where we were set to work again, united in a common drive for freedom. You must go far back into history to find a similar situation—not for 1500 years back will you find a precedent. Then the Romans and the Gothic tribes after having fought each other for more than 10 years, tooth and nail, ceased fighting and joined forces in order to repulse the common enemy from the East—an enemy who threatened both the Romans and the Goths—and in the battle of the Catalonian fields in the center of Europe, the united armies of the Romans and the Goths beat the Huns and saved the freedom of the Western world. Our actual situation today is not so different from that of that of the year 451 A.D. Again an army from the East is threatening nations which had fought each other. Again the history of the world will be decided for a thousand years. Again the freedom of all is at stake and again there is only one means of saving the world: the union of all those for whom freedom is still a treasure worth fighting for. Let us hope that a new battle of the Catalonian fields can be avoided by standing together, prepared to deter any future aggressor. But in some way the war is on already in our days. It is called a cold war; nevertheless, it has front lines. Everyone who comes from the front lines can't help but refer to his experience there. The area I left to visit Chicago is one of the front lines of the cold war. It is the Iron Curtain in Europe. 30 miles from the village where I am living, you will find the first Soviet posts guarding the Iron Curtain. In the house where my ancestors lived for about 700 years, Soviet soldiers are stationed. The dungeons which had not been used since the dark Middle Ages are lodging prisoners again—men who have lost their freedom in their futile efforts to choose freedom. That is what we are fighting for, that is what is at stake: freedom, personal freedom—*Freedom* means the opportunity to decide what we are to *do* and how we are to live—the opportunity to act according to our innermost convictions, and, what is more, to show and to proclaim these convictions; *Freedom* means freedom of speech and, above all, freedom from fear that we do not have to tremble and shake at each ring of the doorbell because there may be a policeman there waiting to take us to the concentration camp or to a prison; *Freedom* means personal freedom with personal, individual self-determination; *Freedom*, implying at the same time individual responsibility. When we fight for freedom we are fighting for both self-determination as well as individual responsibility.

Now, it stands to reason that he who is striving for freedom must not betray it. There is only one freedom, and a freedom that is indivisible; it is both self-determination and individual responsibility. So we cannot hope to save freedom when we destroy self-determination and self-responsibility within our own ranks. The fight for freedom must start at home, in our political life as well as in our economic life. We are on guard for personal and political freedom and we know that freedom's price is vigilance. Freedom is indivisible.

In economy, however, there is discussion as to whether free enterprise or planned economy would be a better means to meet the challenge of the future. In my opinion this discussion is starting from a wrong basis. We would jeopardize the confidence we have in ourselves and the confidence others have in us if we sacrifice the freedom of enterprise in our effort to win the battle for freedom. The cold war of today is a war not only between two great powers, not only a war between continents, between East and West, but a religious war. It is a war we are fighting for freedom. Hitler, too, fought the Russians, but he did not convince the world with his claim that he fought them in order to destroy Communism because there was almost no difference between his regime and the regime that he tried to destroy. His war against Stalin was but a race for supremacy between two slave holders.

That war had a frightful, terrible end for Germany. The whole country was broken down into a field of ruins inhabited by a browbeaten race. But there was one thing that the German nation regained in this frightful disaster—at least in the West. That was *personal freedom*. It was the enjoyment of this regained freedom that gave the defeated nation the first impulse to try to revive. If you ask me about the causes for the German revival, I should give you these two principal reasons: regained freedom and American help; but first regained freedom. It was a thrill for all when on the 21st day of June 1948 all economic restrictions of the Hitler period and of military government ceased, and the way was open to free enterprise. It was stiff competition that followed, it is true, but the result of this competition was the gradual, but assured recovery of the German economy to a degree that nobody thought possible. The man who was fit could show that he was able to work. He *had* to show it because he couldn't count on help from the State, and he was proud to show that he could go on his own! It was a

RECOVERY

by Baron Friedrich August von der Heydte

EDITOR'S NOTE: *Baron (Professor) Friedrich August von der Heydte of the University of Würzburg, Federal Republic of Germany, was in command of the German 6th Parachute Regiment at the time of the Normandy Invasion. His forces engaged in the Battle of Carenten in June 1944 with General Maxwell Taylor's (Army Chief of Staff) 101th Airborne Division. Six months later at Bastogne, Baron von der Heydte received a refusal of surrender from General Anthony McAuliffe. Baron von der Heydte received degrees from several leading continental universities and is presently an educator, lecturer and author of several publications. Your editor interviewed Baron von der Heydte in Chicago on February 19, 1958, at the Military-Industrial Conference, and the following article was arranged for the readers of* SIGNAL.

thrill: the thrill of freedom!

Freedom *is* a thrill indeed, a heartfelt thrill; however, he who does not have the courage to risk his all for the adventure of freedom will never live to enjoy it.

This is so in spite of the fact that the central motive of our day seems to be security, not freedom. It is unfortunate that there are people today who are ready to sacrifice freedom in order to get security. They do not realize that freedom and security are inseparably linked together, so much so that either you have *both* or you have *neither*. The longing for security has brought about more planning in the world than there ever was before. This restless urge for planning is a symptom of the ill-fated struggle for security. Let us not underestimate the importance of planning, but exaggerated planning must lead freedom to its grave. I repeat: freedom is indivisible, and we can't fight for freedom by means that would be the end of freedom in a certain domain. Free enterprise on the other hand does not mean that we can do without any planning. On the contrary, there is very precise planning under the rules of free enterprise. This planning has to be, however, an individual personal planning; it must not hamper free enterprise but, rather, give it new and vigorous impulse. The plans must be freely accepted and not imposed. They must be the result of free cooperation on the basis of mutual confidence.

Governmental planning is a corrective activity, but it does not necessarily mean governmental enterprise. The government must not be a producer but remain a consumer and must leave production to free enterprise, even in a case where such corrective activity is unavoidable. Only free enterprise can provide us with quality, because quality is a direct result of competition, and there is no competition without free enterprise.

But lest I become too general, my first purpose is to concentrate on the reasons for Germany's rapid recovery. One of these reasons was the system of free enterprise we enjoy. It provided the psychological impulse and the tactical basis for everything that was accomplished in the economic field.

The other reason for Germany's recovery, as I mentioned, was American help. Let me expand a bit on that. I presume many are acquainted with the figures of what the United States gave to my country in financial and economic help. It is enough to say that Germany's recovery would not have been possible without this generous help, but let me point out another fact which is not so commonly appreciated, if indeed it is known at all. The American help did not start with the Marshall Plan and with the governmental planning for the European Recovery Program; it started years before with the CARE parcels and private, individual help—from individual to individual—the kind of help that originates exclusively from private initiative. Of course, if you would look merely at the figures of how much was spent for the CARE parcel action first and then how much for economic aid, and if you would view these figures on a comparative basis, then this private help during the first years after the war cannot be compared with the governmental help that has been given since 1947 when the U. S. Government decided to take the problems of European recovery into its own hands. The psychological effect, however, was as great from private help as it was from the enormous governmental assistance. It was not the big governmental program the German man-on-the-street read about in the papers that lifted the ordinary German citizen from that desperate indolence and inactivity he was thrown into by the terrible end of the war. No, it was the CARE parcel that reached him in that moment of despair, the personal, individual help he got when he still felt the contempt of the world which disdainfully beat at him, and when he felt the measures by which the victors meant to keep him down under. It was this CARE parcel that gave him the courage and the enthusiasm to begin a new life and to start rebuilding his ruined country. In many cases this kind of individual help meant the difference between starvation and survival; most of all, it overshadowed the horrors of destruction and cemented a deep and lasting friendship between the victors and the vanquished. The CARE parcel action was followed by the financial help under the foreign aid program, and owing to this assistance my country became, I hope, a stronghold of the free world.

Today, there are people who pretend that American financial aid—at least when given to countries like the Arab States—has no value for the defense of the free world. These people cannot be right. This financial and material help *does* have an effect, and it will have a very significant effect provided the help links personal contacts—contacts from man to man, contacts that influence public opinion and the ordinary man's thinking and doing.

For an Arab, it does not matter at all where his gun is made or who delivered it to him. He will shoot an American with an American gun as readily as he will shoot a Russian

United Nations photo

with a gun he got from Russia. What matters is who showed him how to use that gun and who became his friend in doing so. For this reason the Russian military experts in the Middle East are much more dangerous than the arms Russia is sending there. I saw this myself during my last stay in Egypt just before the Suez crisis. By forming human relations, they are preparing the ground for Soviet politicians —the ground from which they hope to outflank Europe in a move that might become decisive for us all.

After the native quarters of Port Said had been destroyed by bombs during the unfortunate action on the Suez Canal, a Soviet ship brought food, medicine and clothes for the victims of the disaster. That bore the Russians more favor than any financial help would have done. Why? Because all help must be human help. It is the *man* that matters and not just the material. Human relations are not only necessary within a factory but also in the international field. In my opinion, it must be one of the aims of our strategy for the future to combine financial and material help with human relations in a much more efficient way than it has been done in the past. We must not try to make other men and other countries dependent upon us by our financial and material help; rather, we must try to make those men and countries which got our help *our friends*. That cannot be done, I repeat, by pure financing and delivery of materials. Both must be coupled and sealed with human contacts to the largest possible degree.

Here I am touching a point which in my opinion is also a determining factor for the success of NATO. One of the weaknesses of NATO's development is that, within this Alliance, human relations have not been built up to a point where a wave of anti-American feeling can be held in check —a wave which hampers the work of the organization. If you had the opportunity to read European newspapers after the Paris NATO Conference, you would have noted a certain pleasure in what certain journalists thought to be America's weakened position. Those journalists apparently did not recognize the fact that whatever weakens America weakens NATO too, and that each European country is just as strong as NATO is. Since we wish to strengthen NATO, we have to overcome any anti-American trends and we cannot do that except by increasing and intensifying human relations—personal relations and personal friendships across the Atlantic. The Atlantic today plays the same role as the Mediterranean had 2000 years ago. It has become the center of the world—the world which we call free. It links us and must not separate us.

Immediately after World War II, a French statesman said that there would be no more tension between France and Germany, if only each Frenchman had a German friend, and each German a French one. What is right for the relationship between France and Germany is also right for the relationship between America and Europe. A lasting friendship between America and Europe can be the only sound basis for NATO; but in the free world, friendship between countries means friendship between men.

For this reason, I regret all cut-backs in the U. S. Information Service in Europe; private initiative must, in this respect, replace governmental efforts. In this way, American industry can do much in creating the climate in which NATO can grow: Gaining friends overseas is one of the great responsibilities of businessmen who have business overseas. To be effective, propaganda must not only be negative: Anti-Communist propaganda is not enough; what we need at the same time is *pro*-American propaganda—not only propaganda against slavery but propaganda for freedom. This propaganda, of course, cannot be confined to mere advertising. It must go far deeper, and it must not only inform people, but win them for friendship.

This is especially necessary following the Russian technological propaganda campaign—a campaign for which the two Sputniks have only been means. We all were shocked by this apparent success, but what shocked Europeans more was the American shock, the so-called Sputnik hysteria. European confidence in the Americans was too great to have such a reaction thought possible.

This stunning shock has gone, thank goodness. The "Explorer" gave the free world new confidence in its own strength. But this shock which has passed can do us a great deal of good, provided we draw the right conclusions from it. We must proceed very carefully in this matter and must not precipitate our judgment. What is it that has enabled the Russian to reach his pinnacle of success in the field of technology? At first glance, the answer will be the Russian educational system that brought up and trained thousands and thousands of technicians and has given them all the opportunities for development and research. But behind all this there stood an iron will and a dauntless energy that has inspired the industrious and has egged on those who could not be inspired. A deeply rooted primitive ideology had been implanted in them from childhood.

When Napoleon was defeated it was said that on the playgrounds of English public schools the outcome of the Battle of Waterloo was decided. What was true 150 years ago is still true today. In our schools and universities the outcome of the battle of freedom will be decided.

However, we must look not only at technical training. In the Soviet Union vocational training, the will to survive, and the ideological education constitute an indivisible unity. It would be wrong for us to conclude from the current Russian spectacular display of technical ability that we should therefore restrict our efforts to further only our vocational training. We need the human approach along with the specialist's approach. We must, therefore, inspire our youth with a will to survive. We must implant in them the will to survive in a free world and as free men. We must give our educational system the necessary and correctly balanced ideological basis. This ideological basis must be recognized as *the* condition for success.

May I touch upon another problem in this connection? It is not only the existing combinations between vocational training, the will to survive, and the ideological orientation that enables Russia to surprise the world by technical success. Another fact must be mentioned too; this is: The combination should exist between research work on the one hand and educational training on the other. The work of a scientific investigator should consist not only of delving deeper into his field and writing learned scientific papers concerning his findings. No, it is only the teaching scientific investigator who through his personal influence can inspire initiative and lead his students to strive for original thought and experimentation. A university professor who is not at the same time a scientific investigator cannot be as effective because he can only pass on, second-hand, the conclusions of scientific research. This essential and natural connection between producing and reproducing, of finding and passing on to others, is the basis of the high social position which all enjoy who are occupied in university work in Russia. We cannot expect our university students to dig deep into their fields on their own initiative if they have been instructed by professors who know their subject primarily through books and papers they have read. An over-regard for, and over-dependence upon printed work leaves little room for new thought to develop. We are gradually becoming swamped in our book study, continually pushing new ideas farther back in our minds. Reciting back the answers learned from the standard texts may broaden the national basis of knowledge, but they can never be expected to deepen it. How can we hope that university students who passed their courses with stock phrases will develop into the probing minds for which our ever expanding scientific program is crying? A last remark in this connection: We cannot wait until our college years to foster the development of the thinking process. We must go back into our high-school or even elementary-school years, where our teachers must show that they would prefer an attempt to understand the subject *rather* than rote memory. Our schools have an equal responsibility to all their pupils, but the needs of their advanced students are too seldom being met. To assign a greater number of problems to the outstanding student is not the answer. He must be given a greater challenge to strain his mind, to use his thinking abilities. The school and university exists to open for us the gates to the world's

(*Continued on page* 61)

FLOAT IT, FLY IT, CARRY IT—

TOUGH NEW MARINE CORPS MICROWAVE RADIO

On remote beaches, atop isolated mountains, in helicopter assaults—wherever the Marines go, their Raytheon microwave communications system goes, too!

The Marines' new radio relay equipment—lightweight, powerful—has an effective line-of-sight range up to 40 miles. Linked in a relay "chain," the system's range can be extended to much greater distances. Eight voice messages may be sent and received simultaneously. Because communications are beamed over a narrow sky path, chances for interception or countermeasures are minimized.

This complete Raytheon communications equipment can be carried by five men. During amphibious landings, it can even be floated ashore.

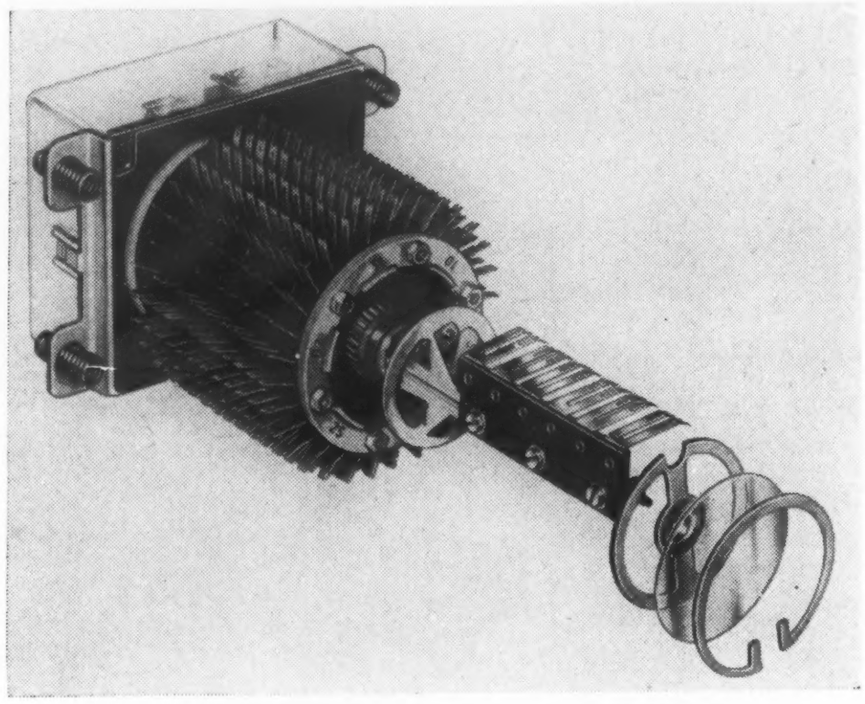
One of the first systems using super-high frequencies to be made in quantity, the new Raytheon AN/TRC-27 is an important advance in tactical electronic equipment.

RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY, WALTHAM, MASS.

NORTH ELECTRIC company



• *The new North Electric 30-point rvf Rotary Stepping Switch. Especially suitable for programing, sequence control, routining test equipment, as a memory device, and for other functions.*

by William Tucker•

FOR 75 YEARS COMMUNICATIONS HAS BEEN A MAJOR product of North Electric Company. Over two-thirds of this prolific period has been devoted to fulfilling prime and subcontracts with reliable systems and components for the Armed Forces, as well as industry and utilities.

Producing crystal detector radio receivers for the Signal Corps during the first World War, this progressive manufacturer has kept pace with past and present changing concepts in military science until, today, North Electric has reached a position among the leading designers and producers of communications equipment and electromechanical and electronic systems and components for the Armed Services.

The episodic years between World Wars found North Electric manufacturing fixed plant telephone switchboards, power controls, relays and components for military and government projects. The company's military activities were intensified considerably in the early 1940's, and North Electric became a prime supplier of head and chest sets, telephones, switchboards, and electromechanical components for the Armed Forces. North Electric's engineering and productive capabilities were instrumental in the design and development of the Signal Corps' BD-100 patching and testing switchboard for the telegraph central office set TC-3. These units were produced exclusively during W.W. II and the Korean conflict.

For subsequent national defense, North Electric assisted in the development and later produced the AN/GTA-6 telephone central group ground support communications equipment for the DEW lines and other similar equipment. Airport lightning control systems were developed for the services as well as water-tight telephones and fixed plant telephone switchboards.

Preceding, during and after the Korean conflict, North Electric manufactured in large quantities SB-22 and SB-86 field telephone switchboards for the Signal Corps.

Recently, the company's staff of research, development and production engineers merged their talents to design, develop and produce AN/TTC-6 trailer-mounted switchboards for the Signal Corps. Concurrently, ground support communications and telemetering equipment for down-range missile projects such as those at Patrick Air Force Base were designed and manufactured. A line of subminiature airborne and sensitive sealed relays was developed to comply fully with military specifications. Thousands of these relays are used by the services from "the ground up," including application in prototype and production-line missiles.

Today, North Electric is also a major participant in the ballistic missile program, designing and producing various ground support equipment, telephone communications and tone-signaling equipment, as well as relays and components. Miniaturized and transistorized transmitters, receivers and audio amplifiers are being prototyped. Government and military products are an important factor in the company's present success.

North Electric gained this wealth of experience from a progressive ability to design and produce precise electromechanical components, electronic assemblies and complex automatic control and telephone systems. With a background as the first manufacturer of switching equipment for the independent telephone operating companies, North Electric has enjoyed enviable years of experience in designing and producing equipment and components for commercial applications.

Many significant communications and telephone "firsts" have been contributed, including the first inside binding post telephone receiver, first semi-automatic telephone switching system, first all-relay switching equipment, first practical crossbar switching system acceptable to the independent telephone companies, and the first one-piece telephone to be accepted by the trade, as well as the public. As a result, North Electric is presently a leading manufacturer for the 4300 independent telephone operating companies throughout the

• *Educated at Carnegie Institute of Tech. and Wayne University, Mr. Tucker has held executive positions with the Avco Mfg. Corp. and the F. C. Russell Co. prior to his election last Jan. to Chairman of the Board and Chief Executive Officer of the North Electric Company.*

Fabian Bachrach

United States, Alaska and the Hawaiian Islands.

The resultant techniques gained from the design and manufacture of this complex equipment led to the design of products and systems with applications outside the telephone field. Shortly after World War II, a new division was established by North Electric to direct the special talents and facilities essential to the new industrial fields opened by this diversification.

Growth of this Industrial Division is closely associated with the rapid acceleration of electromechanical and electronic automation in industry. The division's scope was swiftly widened by ready acceptance in industry of the demonstrated know-how of North Electric's engineers. Customers of this division include many of the world's leading names in the original equipment field and electronic and automation industries—Westinghouse, Radio Corporation of America, Motorola, General Electric, Hughes Aircraft, Remington Rand, Raytheon, Teleregister, and Hobart, to name only a few.

North Electric engineers have devised equipment from the simplest communications control centers for railroad yards to highly technical applications of relays in computer systems, such as those capable of switching the high-speed digital pulses employed in current data processing equipment.

Telemetering in several forms has been an important application of North Electric systems for many years. One important development of this type is the supervisory control equipment to provide remote control and supervision of unattended power substations of electric utility systems, hydroelectric generating stations, water supply systems, gas and petroleum pipelines and similar applications. The demand for absolute reliability, which is inherent in North Electric design, is paramount in this equipment.

Commonplace at North Electric are such commercial projects as the development of a remote control system for closed-circuit TV cameras, automatic toll collection systems for turnpikes, toll bridges, etc., production line automatic test equipment for hi-fi amplifiers, computer assemblies for automatic product sorting and pricing, switching modules for numerous types of data processing equipment, etc.

As the unique talents of North Electric for this specialized type of development are recognized by a widening field of manufacturers, the Industrial Division has become a most important factor in the supply of engineering know-how and production of automatic control and communications systems. A sizable portion of North Electric's engineering and production is devoted to special systems developed and manufactured in collaboration with other companies.

Since the termination of the Korean conflict, North Electric Company has doubled its facilities to its present 250,000 square feet of floor space and doubled employment to approximately 2,000 persons. The office, plant and equipment are among the most modern in the industry. A healthy, progressive, dynamic spirit prevails throughout the entire organization.

Centrally located in the industrial heart of America, in Galion, Ohio, North Electric is readily accessible via direct rail from most locations or by means of main highways or by air. North Electric has long been the pride of its community.

This 75-year-old veteran, with the spirit of challenge usually associated with youth, is an organization that is working today with the vision of tomorrow.

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German Outlook (*Continued from page* 58)

store of knowledge. But, as the amount of necessary information which we must learn grows, we are little by little losing sight of the fact that the main gate which our investigating professors must open is not to learning but to thinking.

In the educational field quantity is always opposed to quality. The Western world must not renounce quality because of the need for quantity—quantity of subjects to be studied and quantity of students to be graduated. Jefferson spoke of the natural aristocracy of talent. We must not forget to foster this aristocracy and to oppose it in the technological oligarchy of totalitarian Russia. We must not try to out-produce the Russians in numbers of technicians and scientists but we must prove that our free society will produce better ones.

I hope you will excuse me if I spoke for a moment as a University professor.

Scientific planning is one of the greatest problems that confronts us. And, I insist, it must be a planning that takes its shape within the framework of freedom. That means it must be a planning that is not imposed on the scholar; rather, it must be a planning in which the scholar has a free and active voice; a planning which is the result of cooperation and not merely a result of governmental dictation. It must be a planning that combines both cooperation and competition. It must exclude all scientific snobbishness and petty jealousies between those who have to coordinate their efforts. I realize that I am touching here on a very sensitive problem. We are all aware of the fact that this *can* occur not only in individual countries of the free world but also in their international organizations, particularly in NATO.

The weakness of the original concept of NATO, in my opinion, was that the military sector was conceived as an independent one, as an autonomous and even a self-sufficient domain. I regard this as dangerous, if not altogether wrong. Today defense is not only an affair of soldiers. The times of independent military planning and action—if there have ever been such times—are gone. Today all military activity has value and sense *only* in its close and essential relationship with other spheres of human existence. It is true, we have in NATO what we may call an optimum of western military collaboration and common military planning. We must also reach that same optimum in all other spheres of our existence. NATO cannot do without it. Again, I am speaking as a professor—I am speaking of the domain I am working in. What we need here is the pooling of our scientific research work, a common planning in the field of science all over the western world—planning without jeopardizing free enterprise and free research.

Common aim needs a common plan. The next task of NATO should be to establish such a common plan in the field of scientific research. That is, of course, not only the task of government officials and politicians; nor is that *principally* their task. They need a consultative scientific council which they can ask for ideas and for evaluation of ideas.

In my estimation, one vital ingredient would be that industry—private enterprise—push forward this idea of pooling scientific research efforts. In a free world this initiative for such pooling must emanate from the operations of free enterprise. Governmental pooling, in this respect, is not the full answer! And, let us not wait until *all* the NATO governments agree to move in this direction. Let's start by private initiative and let's start *now*. Our governments will appreciate it and will gain strength and security from our initiative.

William W. Kaufmann said in his book "Military Policy and National Security" ". . . in an age of hydrogen bombs and guided missiles, we will find that steadiness of purpose combined with flexibility of means and action in the military realm are more than ever required in order to secure our independence and uphold our rights." (p. 266 f.)

This is right not only for the military domain; this is right for us all—and for all our activities in the defense of freedom.

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COMPLETE COMMUNICATIONS SYSTEMS

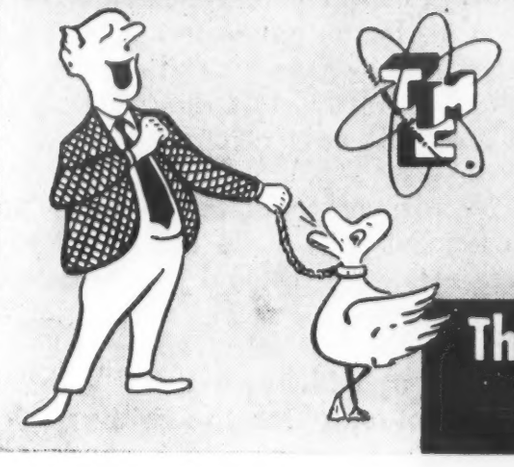
SSB

AN/URA-23

MODEL SBE-1

WRITE FOR BULLETIN 195B

EXCITER • SSB • DSB • ISB WITH OR WITHOUT CARRIER • AM • CW



The TMC SBE-1 is continuously tuneable in the range of 2 to 32 megacycles and is frequency controlled by means of temperature controlled crystals or external VFO. Sideband selection is accomplished by a specially designed filter. The carrier may be suppessed to 55 db. Harmonic and spurious output are at least 40 db. down. VOX (voice control with anti-trip features) is built-in and adjustable. The SBE-1 provides at least 2.5 watts PEP output and could be followed by any appropriate AB-1 amplifier.

The illustration shows the basic exciter unit, without power supply. The unit occupies 8¾" of a standard WE relay rack. The power supply occupies 5¼" of additional space.

The TECHNICAL MATERIEL CORPORATION

IN CANADA
TMC Canada Ltd., Ottawa, Ontario

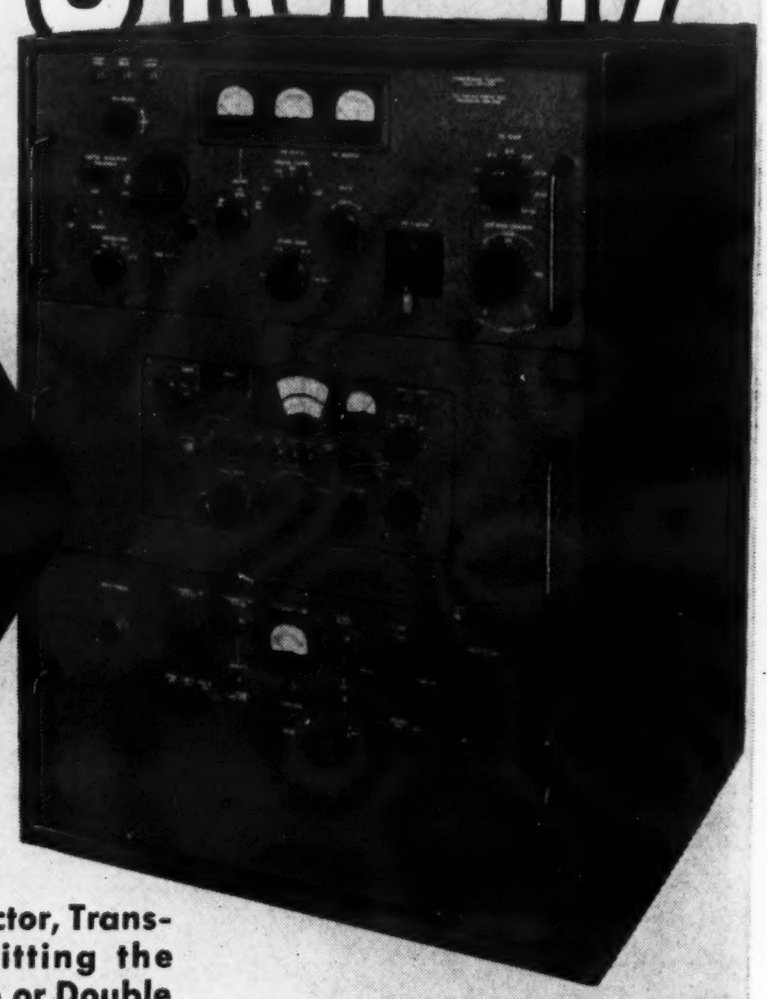
Main Office: MAMARONECK
NEW YORK

MS FROM 5 WATTS TO 50 KILOWATTS

AN/URT-17

MODEL **GPT-750(D)**

- SINGLE SIDEBAND — SUPPRESSED CARRIER
- INDEPENDENT SIDEBAND — SUPPRESSED CARRIER
- DOUBLE SIDEBAND — FULL CARRIER — SUPPRESSED CARRIER
- FREQUENCY SHIFT
- CW-MCW-AM



The TMC Model SBE-1, Mode Selector, Transmitting, is a universal exciter permitting the transmission of any intelligence on Single or Double Sideband, with or without carrier.

The exciter may be used for simultaneous or independent transmission of intelligence on either upper or lower sideband. For example: A voice channel can be transmitted on the upper sideband while tone multiplex is being transmitted on the lower sideband.

The SBE-1 provides the following commonly known types of operation:

1. **Conventional Double Sideband, AM, with the additional advantage of carrier level control.**
2. **Conventional Single Sideband with adjustable carrier insertion.**
3. **Conventional Interrupted Carrier, CW, or Sideband Tone CW.**
4. **Independent Sideband transmission with adjustable carrier insertion.**

From the above paragraphs, it should be apparent that the SBE-1 provides transmission which is compatible with any of the current "controversial" systems.

The TMC Model GPT-750, Radio Transmitter provides radio telephone, telegraph, frequency shift and facsimile operation on all frequencies within the range of 2 to 32 Mc.

The GPT-750 is a field proven equipment, service tested, nomenclatured (AN/URT-17) and approved for service use. This transmitter has been used for fixed plant, mobile and shipboard operation and provides 1000 watts output CW and FS, 750 watts output radio telephone (high level modulation) and 750 watts output, PEP, single sideband, all on a continuous commercial service basis. Band switching in all stages.

WRITE FOR BULLETIN 174C

THE TECHNICAL MATERIEL CORPORATION

Part I

the importance of electronics in

PSYCHOLOGICAL WARFARE

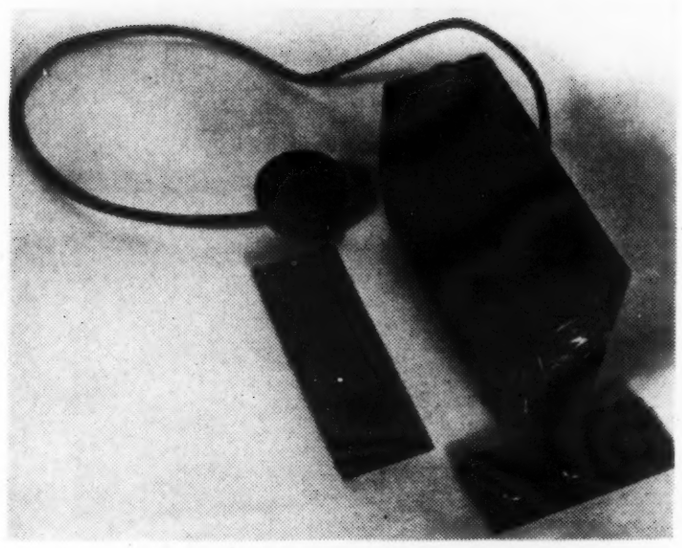


Figure 1: Throw-Away Radio, AN/PRR-5

Figure 2: Illustration of a possible future spherical receiver

by Captain Albert R. Laue, Signal Corps

Instructor, Psychological Warfare Department, USA Special Warfare School
Fort Bragg, North Carolina

How IMPORTANT ARE ELECTRONICS TO PSYCHOLOGICAL warfare? The answer is: all-important.

Why this is so becomes crystal clear when one realizes that psychological warfare is basically a process of communication. Functionally, it is an instrument of national policy employed by a government to influence the emotions, attitudes, opinions and behavior of specific foreign target groups in a predetermined direction. To reach these target groups, or target audiences, psychological warfare today depends almost entirely on the media of mass communication—radio, motion pictures, the press, public address systems and television—to mention just a few of the more important ones. With the sole exception of the printed media, all of these owe their very existence to electronics. Even the printed media have been benefited by a number of technical improvements during the last few decades, thanks to the application of new techniques made possible by certain electronic developments.

Psychological warfare as an instrument of policy is as old as mankind itself. Biblical and pre-Biblical sources cite many examples of its employment by ancient rulers to gain their political objectives in war or just short of warfare. Its effectiveness, then as now, depended largely upon the means of communication available. This dependence always imposed a severe limitation on the employment of psychological warfare. When the advent of electronics made possible the development of the modern media of mass communication, psychological warfare was able to outgrow this limitation. It was consequently able to register the first really significant development in the state of the art in over 3000

years of recorded history. Therefore, it is no exaggeration to say that psychological warfare, as we know it today, simply could not exist without electronics.

Developing New Techniques

One of the most fascinating aspects of our work in the Psychological Warfare Department of The United States Army Special Warfare School at Fort Bragg involves the study and evaluation of new scientific and technical developments from the viewpoint of their applicability and potential value to psychological warfare operations. In this field, close coordination is necessary with the Combat Development Office (CDO) of the school. Its functions include the development of doctrine, of new concepts and techniques and of requirements for new or improved material. Some of the items we have been asked to study by CDO have been such as to open up utterly fascinating new potentialities of application in future psychological warfare operations. The majority of these items has either come or evolved from new discoveries or developments in the field of electronics. Our resident courses include a number of periods officially titled, "Technical Aspects of Radio Operations" and "Technical Aspects of Loudspeaker Operations." A portion of these periods is devoted to the presentation and discussion of new developments and their potential future application in psychological warfare operations. These periods, popularly called "science fiction sessions," generate a tremendous amount of enthusiasm among the students for psychological warfare by stirring their imaginations and allowing them a preview of things to come.

That the future of psychological warfare is as inextricably intertwined with the progress of electronics as has been its past is easily demonstrated.

Reaching New Audiences

Psychological warfare is constantly searching for new and better and, if possible, cheaper ways of reaching more potential target groups. Radio is one of our most effective media because it enables us to overcome the barriers of time, space, illiteracy and political boundaries and to bring our message to vast audiences in all parts of the globe. But radio also has its limitations as a psychological warfare medium. One of the most severe of these limitations is the lack of receiving equipment among certain important potential target groups, such as the inhabitants of the so-called under-developed areas and enemy combat troops.

To appreciate how serious this limitation can be, we need only think of the 600-million people living behind the "Bamboo Curtain." There are, according to latest estimates (UNESCO, 1956), only some 1.5-million tunable radio receivers in the hands of this vast audience spread over an area of 3.7-million square miles. Moreover, these radio receivers are primarily concentrated in the large urban centers and controlled by politically reliable persons. Even though we know that there are a number of radio receivers being operated clandestinely in China today by the so-called "long ears," who disseminate the message by word of mouth, it would be farcical to speak of radio in China as "mass communication."

There are many areas in which the distribution of radio receivers is even sparser than in China. Thanks to certain recent developments in electronics, however, the situation is far from hopeless. The solution to the problem, made possible by the miniaturization trend in electronics, lies in the mass production and distribution of expendable radio receivers. These throw-away sets are self-powered, lightweight, rugged. tamper proof and cheap. They can be literally thrown into such areas and thus create listening audiences for psychological warfare radio where none before existed.

First Throw-Away Radio

The first receiver that came close to meeting these requirements was the AN/PRR-5 (Figure 1). Five prototype sets were produced at USASEL at Fort Monmouth and tested by the Psychological Warfare Board, forerunner of CDO, at Fort Bragg. One set was dropped 500 feet in free fall from an aircraft. Although the plastic case was cracked by the impact. the set was completely operable after this somewhat rough treatment. Sets dropped with small parachutes from various altitudes suffered no ill effects. The battery life of the set was approximately 500 hours of operation. The set weighs about 2½ pounds and includes an earphone with built-in, push button switch, a tuning control (550-1600 kc), a volume control and external antenna and counterpoise connectors. The mass production cost of the AN/PRR-5 was estimated at about $7.50 per set.

New Concept Here To Stay

Although the AN/PRR represented a good first step in the right direction, it will never see a production line. By the time the testing and evaluation were complete, everything about it, except the basic concept, had been rendered obsolete by new electronic developments. But one thing is certain, the expendable radio receiver is here to stay. When it will go into mass production depends on when the necessity for the employment of such sets on a mass scale will arise. What it will look like will depend on what the electronics industry will be able to offer at the time the production requirement arises.

If the expendable radio receiver were to go into production today, it would probably have the following characteristics. Its size would be about that of a package of king size cigarettes, although it would not necessarily have to be box shaped. It could, for instance, be spherical in shape, in which case its size would be about that of a softball (Figure 2). It would use transistors and printed circuits and have a small speaker. It would have a built-in highly directional loop antenna which would permit volume control by rotation of the set. It may be tunable, or may be "frozen" at a preset frequency, depending on the specific operation involved. All components, including the batteries, would be potted to preclude tampering with the set and cannibalizing of components for other uses. If this were not done, we might find ourselves in a position of providing a wartime enemy with a gratuitous supply of radio parts which may be in short supply in his wartime economy.

Compared with the "sales appeal" transistor receivers on the market today, the expendable radio receiver of tomorrow may have a practically unlimited operational lifetime if powered by solar batteries, another new development of the electronics industry (see SIGNAL, July 1957, page 72), in lieu of conventional batteries.

Problems Solved By Electronics

The case history of the expendable radio receiver is a typical example of how specific developments in electronics have solved a very vexing problem that has plagued psychological warfare for some time. It is typical because psychological warfare operators are constantly looking to electronics for the solutions of many problems. The very encouraging aspects of this somewhat one-sided relationship is that, once a specific problem has been, so to speak, laid at the doorstep of electronics, it usually does not take very long before electronics "delivers the goods." To illustrate this point, let us consider another major problem faced by psychological warfare radio and how electronics can, and no doubt will, solve it.

The problem is enemy jamming. Jamming is the only really effective countermeasure against psychological warfare radio operations. It is interesting to note in this connection that the Soviet bloc annually spends much more money on jamming Western radio broadcasts than the United States spends on its radio operations behind the Iron Curtain. Jamming can be overcome to a certain extent by the application of certain well-known techniques. These techniques, however, are successful only to the extent that weaknesses exist in the jamming system. There is only one way to overcome an effective jamming system and that is to "drown out" the jamming signal. This requires that your signal must be stronger at the point of reception than that of the enemy jammer, so that the listener, by reducing the volume on his receiver, can subdue the jamming signal sufficiently to leave the jammed signal audible and intelligible.

There are two ways to achieve this condition. The first is

to increase the output of your transmitter. Since the jammer normally holds the advantage of being located much closer to the target, this system has obvious technical limitations. The second method of achieving a stronger signal than the jammer at the point of reception is to move your transmitter closer to your target than the jammer. One way this can be done is by airlifting the transmitter to the target area by balloon and beyond the reach of both antiaircraft artillery and interceptor planes. This method does not take it beyond the reach of rockets, however. Manned balloons have in recent tests taken heavy payloads to altitudes above 100,000 feet and have stayed there over thirty hours. Unmanned balloons can exceed these altitudes and can presumably stay up for two or three weeks. Wind directions vary at different altitudes, so that a balloon can go anywhere by "hitchhiking" on the right air stream.

Thus we have in the balloon a vehicle that will take a transmitter to the target area and will drown out the signal of any ground-based jammer, except in a small circle around the jammer. By the same token, our balloon-borne transmitter, if broadcasting on the same frequency as the local transmitter in the target area, would drown out that transmitter and would thus, in effect, become a jammer. To counteract this, the enemy would have to jam on his own station. It is easy to see that this gambit offers many interesting possibilities.

A few minor details, however, remain to be worked out before this system can be employed with reliable effectiveness—minor because again we feel that we can look to electronics to provide the solutions.

To begin with, we need a small, light, cheap, yet fairly powerful transmitter. It would, of course, have to carry its own power supply. Ideally, it should have as little metal in it as possible so that, while not actually transmitting, it should make a very difficult target for tracking radar or homing rockets. The balloon itself, being made of plastic material, does not reflect radar and the gondola could likewise be made of plastic. With a minimum of metallic components, the transmitter should therefore, due to its small size and high altitude, present a minimum target. There are two ways of approaching the problem of defense against homing rockets while the transmitter is on the air. One would be to have a device that would detect any metallic object within a given radius of the balloon and automatically shut off the transmitter, thus depriving the approaching missile of a signal to home on. The second approach would be to have the balloon-borne transmitter in mass production and therefore considered expendable. The certainty that one such transmitter shot down by rocket would immediately be replaced by another would then make it a very unprofitable target for an expensive missile. In view of the next point to be discussed, the second approach appears to be the more practical of the two.

Secondly, we would need a system of remote navigation for the balloon. Such a system would consist of two essential components. The first is a radiosonde type of transmitter that would flash to the control crew at home base data on the balloon's exact position, altitude and flight conditions at all times. The second component would be a radio circuit enabling the control crew to control remotely the valving of gas and ballast to enable the balloon to gain or lose altitude.

The third problem requiring solution involves a system enabling the control crew at home base, by remote radio control, to turn the transmitter on and off and to select the programs to be transmitted. The programs would be prerecorded on tape. Several small lightweight tape reproducers with automatic rewind devices would be installed in the gondola. The ground crew could then select any one of the available programs by remote control in much the same way as you select a record on a juke box. When the balloon reaches another target area, the same programs could be repeated.

Based on the past performance of our electronics industry, as stated above, there is every reason to assume that these problems can be solved in short order, thereby making the system described previously a practical reality and enabling psychological warfare radio to overcome enemy jamming effectively.

Prospects for Television

What has been said here with respect to radio applies equally to television as a psychological warfare medium. If the current trend in miniaturization of electronic equipment continues, it is quite conceivable that in the not too distant future we may also have small expendable television receivers and balloon-borne television transmitters utilizing video tape. The expendable TV receiver, needless to say, would not be the sort of receiver you would be proud to have in your living room, but it would enable psychological warfare to create target audiences for this powerful medium where none before existed. To a person who has never seen TV, even a 3 x 4 inch living, talking picture would seem like a miracle. There can be little doubt that such a person would be strongly influenced by whatever message that living, talking picture would communicate to him.

The expendable radio and TV receivers will not only make it possible for strategic psychological warfare to reach entirely new target audiences, but they will also revolutionize tactical psychological warfare concepts and techniques. Despite the significant improvements made in combat loudspeaker equipment (since the Korean War), again thanks to electronics, the loud-speaker still has an inherent weakness that makes it incapable of competing with radio as an audio medium on the battlefield. It can be heard over a distance of only a little over a mile and it is questionable whether opposing troop units will ever find themselves within a mile of one another in modern war. Radio and eventually television as well, utilizing expendable receivers to create a receiving capability among tactical target audiences, will have to take over the functions hitherto carried out by the combat loud-speaker.

Gauging Audience Reaction

Another recent electronic development, the telescopic microphone, may enable the psychological warfare operator to obtain unbiased, candid answers to a question that is constantly uppermost in his mind—How is my target reacting to my communication? Its primary application will be in consolidation psychological warfare operations, in which the target audiences are civilians in areas that have been wrested from enemy control. In these areas, be they considered liberated or "occupied," i.e., part of the enemy homeland, consolidation psychological warfare utilizes all the media of mass communication available to bring its messages to the people. It is not altogether inconceivable that ways and means may be developed to employ telescopic microphones for the same purpose in strategic and tactical psychological warfare operations as well.

Communication Content

As we have seen, recent developments in electronics have had a profound effect on two aspects of the communication process involved in psychological warfare operations, namely the means of reaching target audiences and the evaluation of target reactions. There is yet another aspect, that of communication content, on which a recent electronic development will have a profound influence. That development is one of the most awe inspiring creations of the electronics industry, the Automatic Data Processing System (ADPS).

To fully appreciate the tremendous potentialities the utilization of ADPS holds in store for future psychological warfare operations, we must again remind ourselves that psychological warfare basically is a process of communication —persuasive communication, to be precise. As such, its effectiveness depends on a combination of factors. These factors are summarized in the formula, "Who says what to whom, by what means and with what effect?" Assuming that psychological warfare operators normally know what effect they want to achieve, what target groups they can reach and what means they have at their disposal to communicate with these target groups, the one all-important question that still demands an answer is, "What are we going to say to our target audiences in order to achieve the effect we want our communications to have on them?"

(*To be continued in the July issue*)

Guiding a missile, or speeding flight and flight environmental data back to control and tracking centers, is too much of a job for conventional communication systems. Supersonic speeds call for lightning fast data communications, coupled with the utmost reliability.

Capitalizing on the ease of converting messages into digital form, Motorola scientists and engineers have developed a number of Data Link Communications Systems suitable for piloted aircraft, as well as missiles.

NERVE CENTER FOR DATA LINK SYSTEMS

With Data Link Systems, messages that have been translated into on-off pulses can be transmitted by any of the common modulation schemes with a suitable carrier. The transmitter can be air-borne, ship-borne, or land-based. Received messages are amplified, decoded, and transformed into a form suitable for display, or stored for some future time, or used for direct control through auto pilots, for example.

One of the Data Link Systems designed at Motorola utilizes an all-transistor converter-coupler, packaged in modular form. The total system consists of eight modules, each approximately 4" x 8" x 1½". The fully transistorized circuitry is of the highly reliable diode-matrix type logical circuitry used in many digital computers. The switch type transistors employed are a product of the Motorola Semi-Conductor Division. Indicative of the stringent testing program to which the transistors are subjected is a 1000-hour life test at 85° C.

For another Data Link program, Motorola has designed a system featuring resolver-type outputs. A single time-shared servo amplifier positions anyone of the five resolvers in accordance with commands from the ground transmitter.

These two Motorola Data Link Systems aimed at solving one of the important communication problems of the missile age are examples of the complex programs conducted by Motorola for varied military needs.

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WE AMERICANS ARE GREAT lovers of peace—peace based on justice and the principle of "live and let live." And yet, we dare not permit our idealism to blind us to the realities of contemporary life. A nation's survival today depends not so much upon law, morality and pious hopes, as upon a cold-blooded and clear-eyed evaluation of the forces at play on the national and international scene, and upon a nation's own power to bring its influence to bear upon other nations. To put it another way, until custom and specific agreements create an international code of morality, a nation's security must continue to rest upon power—not military power alone, for this is but an outer evidence of authority, but by such less ostensible factors as geography, climate, material and human resources, industrial capabilities and over-all economic strength. Within this concept, there are five basic factors which are essential if we wish to enjoy economic strength and promote the welfare of our nation. They are Manpower, Materials, Money, Manufacturing and Management. The first two factors are fundamentally essential to any productive effort. The lack of either of the two can seriously hamper or damage a nation's power position in the world today—and it is not alone a question of *quantity* of each available to a nation, but the quality as well.

Technological Progress

Let us briefly consider manpower for it alone is an indispensable ingredient for technological progress. Technology presupposes that progress in this field results from educated manpower. From the educational viewpoint, our present school systems may be characterized as doing a satisfactory job of educating a larger percentage of our population than in the past. Is this enough? There seems to be an accepted concensus that our educational program is falling short in some vital areas. For a variety of reasons, the quantity and quality of our production of scientists and engineers is much less than we would like it to be. For, in technological progress, it is the scientist and engineer who develops, the skilled labor force who produces, and the skilled technicians who operate and maintain the complex weapon systems and hardware of our military forces.

As for manpower in our Armed Forces, in critical skills, the re-enlistment rate is usually on the low side and the turnover of personnel approaches a dangerously high point. To train the flow of replacements for the military alone requires a substantial investment in personnel and training facilities.

Education a Necessity

With the advent of Sputniks and the accompanying frustration caused by USSR breakthroughs into outer space, comparisons of our educational system with that of the Soviets become the order of the day. Even if there were no USSR, with its population 50 million greater than ours, the necessity of strengthening our educational system would still confront all of us. It is a problem whose solution is long overdue.

Our population has increased three times during the past 75 years and our standard of living has constantly risen. Our gross national product climbs upward yearly reflecting our economic growth. If our economy continues to expand at recent rates,

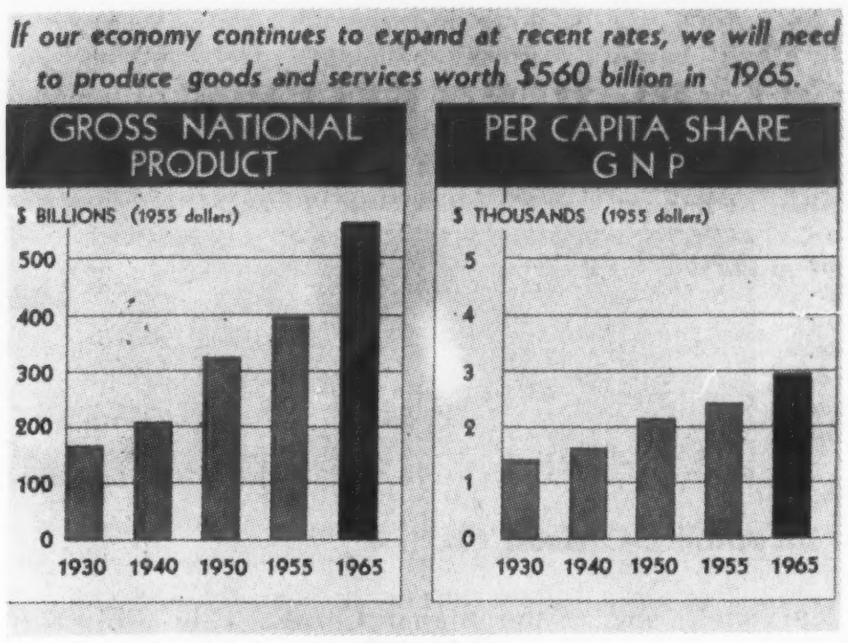


Figure 1

• *A gross national product of $560 billion in 1965 will require the employment of 74 million people.*

YEAR	Number Employed (MILLIONS)	Gross National Product (BILLIONS) 1955 dollars	Value of Goods and Services per Worker
1930	45.5	$165	$3620
1940	47.5	208	4370
1950	60.0	322	5370
1955	63.2	391	6190
1965 (estimated)	74.0	560	7500

Figure 2

we will need to produce goods and services worth $560 billion in 1965 (Figure 1). A gross national product of this magnitude will require the employment of 74-million people (Figure 2). But just people is not the answer to progress. We have already used large quantities of our national resources to a point where it is no longer possible for America to progress solely on domestic raw materials. More people add to our material shortages. With the year 1965 not too far distant, something has to be done to insure the maximum utilization of our manpower which is so necessary for our continued growth and economic stability. One sure answer is to have more qualified, educated and trained people to solve our problems. After all, the development of brain power through education is a basic requirement for national security. (See Figure 3).

Our crucial manpower problem of the next decade will be our limited growth in the number of men 25 to 44 years of age. At the same time we can expect a decrease in younger executives and leaders to keep pace with our technological and economic advancements—this in light of the fact that our population trends indicate a 10-million increase in our total labor force by 1965 (Figure 4). While the USSR and the US compare rather favorably as to the total number of scientists and engineers, the current flow of new graduates in these fields in the Soviet Union is much higher than in the U. S. When comparing the US *vis a vis* USSR, it is only fair to state that the US does not have significant up-to-date data on its critical manpower resources.

Conclusion

In conclusion I would like to re-emphasize the following points.

Manpower as a factor of national power is indispensable to our maintenance of a position of strength, to our ability to fight a war, to our economic growth and to the formulation of a national strategy which places heavy demands on all our human resources.

Moreover, manpower is a product which has a long lead time—a product for which we can develop no substitute.

The means of achieving the skilled manpower we need are crystal clear —yet so controversial. We must provide for better schools, for the necessary teachers and better school facilities for our young people. Whether we do it on a family plan or with Federal assistance, it must be done.

We must produce the incentives for our young people to enter those fields of engineering, science and technology on which national security and world leadership depends.

We must make it possible for the military to require and retain skilled technicians and qualified leaders if our complex weapons systems are to function.

We must get the maximum productivity from the technical trained people we now have in order to bridge the gap created by the institution of a program for educational advancement.

Finally, the demand for scientists, engineers, and technicians is competitive, and it is essential we acknowledge the fact that we are dealing with people. Our planning must, therefore, be spiced with the element of human relations to be successful.

Figure 3

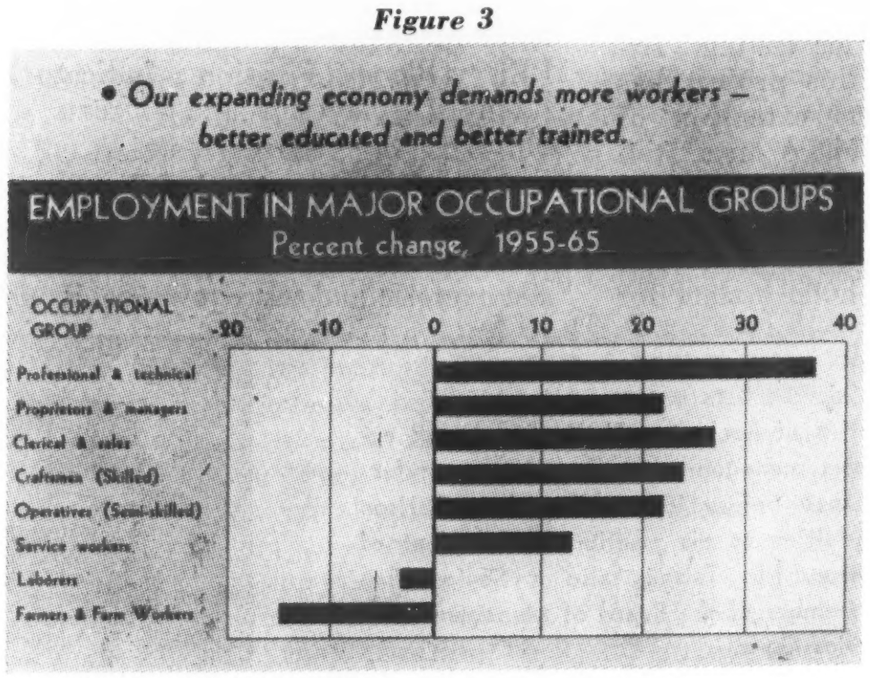
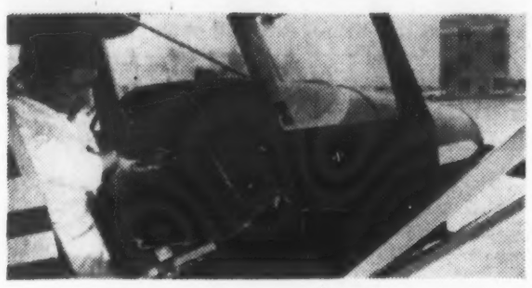
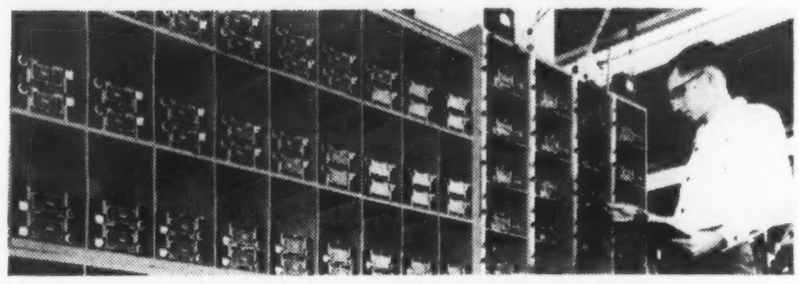


Figure 4

STROMBERG-CARLSON'S ROLE IN U. S. DEFENSE





Left: Technician holds airborne unit of LABIL (Light Aircraft Binary Information Link) communication system, opened to show unique book-type construction. Right: AN/ARN-32 Marker Beacon Receivers undergoing 48-hour test, in Electronics Division of Stromberg-Carlson.

by Robert C. Tait, President, Stromberg-Carlson Co.

SINCE ITS FOUNDING IN 1894, Stromberg-Carlson, now a division of General Dynamics Corporation, has played a major role in furnishing vital electronic and communication equipment for the U. S. Armed Forces.

Over a long period of years, dating back to World War I, a large share of this equipment has been produced by our company's Telecommunication Division. This division has just recently moved into new and enlarged quarters, making possible much closer coordination between engineering and manufacturing departments. This has resulted in improved availability schedules, both for our conventional products that are used by the military and by telephone operating companies alike, and for the specialized communication equipment required for defense.

We feel that it has been fortunate—both for Stromberg-Carlson and for our nation—that much of the equipment we have developed for civilian use has been found to meet the requirements of the Armed Forces, and thus could be made available to all the services more quickly, and at lower cost.

An example of this is Stromberg-Carlson's dial telephone system. Since World War II large "XY" dial telephone exchanges similar to those installed in civilian telephone central offices all over the country have been placed in service at such permanent military installations as Fort Monmouth, Fort Knox and Fort Sam Houston. Some 50,000 lines of additional telephone switching equipment also have either been shipped, or are being currently manufactured for other undisclosed destinations. Stromberg-Carlson also has supplied dial PBX boards for such locations as the first Texas Tower, Eniwetok Atoll and Cape Canaveral.

An "XY" toll ticketing system, used to verify, record, compute and prepare billing slips for direct distance dialing, is presently serving Ft. George G. Meade, Maryland, and other such systems are on order for similar installations.

A complete national telephone network, including switchboards, carrier-microwave equipment and telephone instruments, has been furnished to the Signal Corps for the Republic of Korea.

Among the other projects completed, or now in process of completion in our Telecommunication Division are AN/TTC-7, tactical telephone communications for the Signal Corps; AN/FTC-13, tactical field equipment for the Air Force; SB-22, manual field service switchboards for the Signal Corps; SB-53, manual PBX switchboards for the Signal Corps, and AN/TCC-14, carrier telephone/telegraph units for the Signal Corps.

New projects now in process of design incorporate the latest techniques and concepts in the art of communication — semi-conductors and other solid-state devices, printed circuitry, the transition from electromechanical to electronic components. In this last area lies what is both the greatest challenge and the greatest promise for the future.

Some two years ago the first all-electronic switchboard ever to be produced was designed and built by Stromberg-Carlson and delivered to the Navy for in-service testing. Experience gained on this project has led to a tremendous extension of effort in this new field. A large staff of talented engineers and technicians is presently devoting an intensive effort to the development of a complete electronic telephone system for the Signal Corps. This project includes all the necessary components of central office switching and accessories, as well as the design of a transistorized telephone instrument incorporating a new theory for establishing connection between the calling and called parties.

In Stromberg-Carlson's Electronics Division the major emphasis is on military electronics, both in the engineering and manufacturing aspects.

For example, the Electronics Engineering Department originated and developed an advanced, high-performance airborne TACAN (Tactical Air Navigation) equipment and integrated navigational system known as NAVTAC which is a complete package, including ILS (Instrument Landing System), TACAN and other navigational aids. The ground beacon for this system, and a test monitor and control system also are being developed in this laboratory.

In the communications field, projects include long-range and short-range command sets—ground, mobile, and airborne. Other electronics engineering activities include extensive work in burst transmission, propagation and vulnerability studies, advanced selective calling devices and squelch circuitry.

This department also developed a large 22" general purpose shipboard PPI (Plane Position Indicator) Radar Display for the Bureau of Ships.

Several groups in the Electronic Engineering Department now are working on the development of missile exercise and test equipment, com-

Mr. Tait, a native of Rochester, N. Y., had broad experience in sales management, advertising, manufacturing and finance before joining Stromberg-Carlson in 1949. In addition to his position as President of Stromberg-Carlson, Mr. Tait is also a Senior Vice President and member of the Board of Management of General Dynamics Corp.

mand beacon instrumentation and other projects of a classified nature. Among the latter is the design and development of countermeasures, and reconnaissance systems. This involves extensive vulnerability and security studies on these highly complex electronic systems.

Recognizing the need for applying transistors to military equipment, an active development of a variety of transistorized devices has been accomplished, including the operation of these devices at extreme temperatures. A number of major data systems has been developed, including an elaborate electronic "nerve system" for control of the nozzle actuators in the supersonic circuit of the propulsion wind tunnel now being built at the USAF Arnold Engineering Development Center at Tullahoma, Tenn. The Electric Boat Division of General Dynamics is the prime contractor on this facility, and Stromberg-Carlson is the subcontractor for the electronic computing and control equipment.

In addition, digital techniques have been applied in communications systems, navigational devices and complex test equipment systems.

Manufacturing in the Electronics Division is carried on, not only on large quantity items, such as the AN/ARN-21, but also specializes in small, short-run lots which are encountered on some of the larger equipments, such as the GRN-9B and the SPS-6C.

Communication equipment of a somewhat different type is manufactured by our Special Products Division. In its military applications this equipment is found as "battle-announce" systems on a great many ships of the U. S. Navy, including all of the nuclear-powered submarines so far placed in service, and on aircraft carriers of the *Forrestal* class, to mention only some of them.

This division also has produced, or is producing, other military electronic gear on subcontracts. These have included such items as the AN/MPQ-10, mortar locater, and the AN/APN-69 airborne radio beacon.

Stromberg-Carlson's Los Angeles plant, known as the Electronic Control Systems Division, is largely concerned with the numerical control of machine tools. Two principal types of systems are currently being produced. One of these is the point positioner, a two-dimensional table which permits a vertical spindle machine tool to carry on such point operations as drilling, tapping, riveting or spot welding without an operator's attention, the operation being controlled automatically by prepared tape.

A more universal system for completely automatic contouring in three dimensions is also available. When applied to a milling machine, for example, it directs the spindle and feeds automatically so that any desired shape may be produced. The preparation of magnetic tape for such machines can be accomplished directly from drawings. Therefore no templates or prototypes are required. Equipment of these types is entirely suitable for small runs as well as for large production, since the elimination of constant attention by an operator does not depend on large quantities of production to justify special jigs, set-ups or fixtures.

Another product of the Electronic Control Systems Division is automatic testing equipment for electronic components, especially solid-state diodes and the like. This product line, known as Astramatic, not only tests such devices for conformity to specifications but can also be adapted to plot quality control data automatically. All of these devices are finding important applications in the aircraft industry.

The division also has developed special skills in data processing, both in special components and in data systems, largely for the armed services.

The product for which Stromberg-Carlson's San Diego division probably is best known is the Charactron Shaped Beam cathode ray tube. This tube, which can display alphanumeric characters in any configuration on its face at fantastic speeds—up to 85,000 characters per second—fills a vital role in the SAGE (Semi Automatic Ground Environment) reconnaissance system, and also has been adapted to a number of important commercial applications. Among the latter is the S-C 5000 high-speed electronic printer, capable of printing 4,680 lines of type per minute.

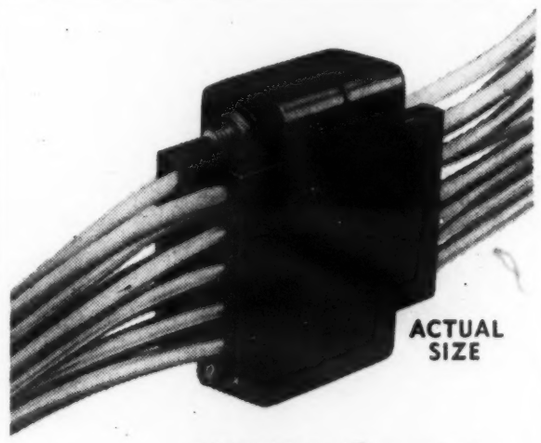
In addition to its manufacturing divisions, Stromberg-Carlson also maintains a separate Research Department. Here about 150 people are engaged in advancing the art of data transmission, processing, storage and display. This includes a great deal of work on digital systems, as well as on the more common problems of voice and message handling.

A recent achievement is the transmission of digital information over a metallic telephone circuit for long periods without error, at a rate many times that normally stated for such transmissions.

Underwater signaling also is an important program, and research is currently underway in an attempt to optimize detection equipment and permit the extraction of the maximum of information from underwater signals. Underwater and air transducer investigation parallels this effort in order that we may have high competence in each important element of this communication complex.

Our speech analysis work also is considered of high importance, pointing toward the more effective use of available bandwidth in communication links. Additionally, the company lends support to a basic science program in the Research Department, relating to work in the solid state. Early investigations in paramagnetic resonance will be our initial concern, relating to the important MASER (Microwave Amplification by Stimulated Emission of Radiation) needs. The responsibility for a program on photoconductors also is placed in this laboratory.

In all of these areas of activity, and in others not mentioned, Stromberg-Carlson's long experience in the manufacture of electronic and communication equipment, and its traditional emphasis on high quality have, we feel, made significant contributions to our nation's defense establishment.



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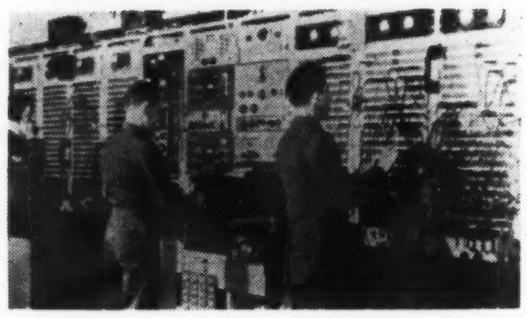
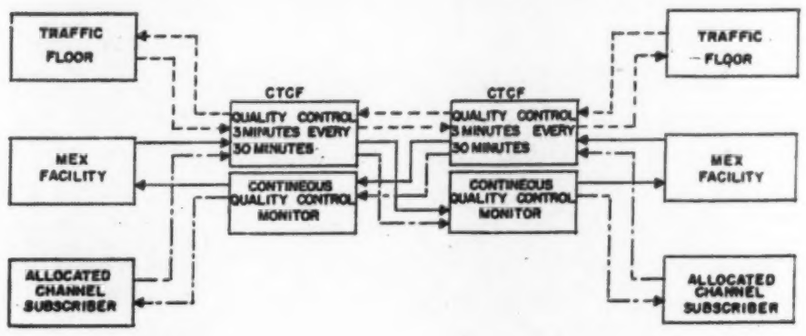


1

ELECTRONIC QUALITY AND CONTINUITY CONTROL CONCEPT
FOR THE PRINTED INFORMATION MEDIA



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HELLO HELLO..MOM?

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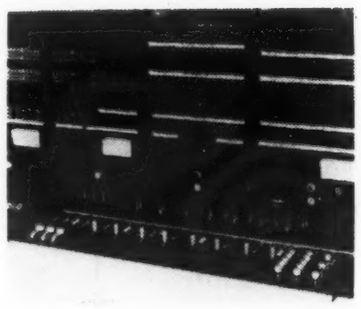

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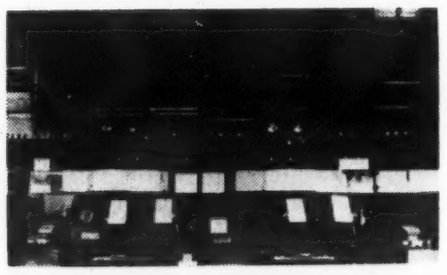

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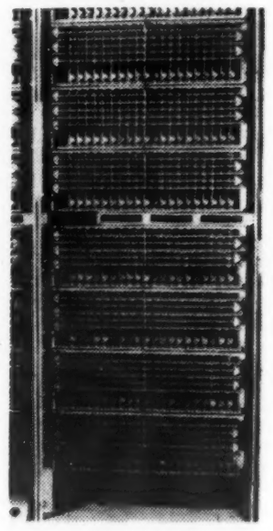

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by
Maxwell J. Richards
Captain
USAF

* the air force approach to world-wide dialing

THE AIR FORCE'S AIR DOCTRINE[1] EMPHASIZES THAT ONE of the predominant characteristics of an air force is flexibility. This doctrine states in part: ". . . air forces can be adapted quickly to various requirements for performance and firepower. They can be diverted rapidly from one type of operation to another at a given location. They can shift the performance of a designated task from one locality to another with a minimum of delay in operation." This flexibility, even when built into aircraft, cannot be accomplished without communications; it is inherently global in nature. Therefore, the communications to support and to provide this flexibility must be global in nature. Global communications to support and provide flexibility is presently being used by the Air Force through a system of communication networks that are collectively called the STRATCOM System.

The STRATCOM System is the U. S. Air Force Strategic Communication System and consists of interconnected Air Force radio stations, leased or allocated long-haul wire and radio channels, terminal equipment, relay facilities, communication centers, cryptographic centers, etc. It does not normally include internal, tactical or special-purpose communication systems of the various commands below the major air command level.

Actually, the STRATCOM System is the U. S. Air Force point-to-point communications pipeline employing both printed information and voice media. The MEX facility, which is a military exchange, will increase the speed of service, circuit quality and circuit efficiency on both these media. The MEX facility has been designed to meet the demands of the tactical Air Force subscriber; however, it has been designed so that it will be expanded to meet the demands of any military or land-based naval commander anywhere in the world. The MEX facility, since it is designed for the tactical subscriber, will not eliminate the USAF Communications Network (AIRCOMNET) or the USAF Air Operations Network (AIROPNET); however, it is capable of seizing AIRCOMNET traffic channels to supply communications to the tactical subscribers on an "as required" basis.

We in the Air Force and in certain Army and civilian communication circles believe the STRATCOM MEX facility is the answer to many of the military communication problems. In the first place, the MEX facility was designed by means of the stepladder approach employing three phases. In the second place, automation and circuit quality are its fundamental guiding principles.

Actually, a number of related factors combined and mushroomed into the requirement for a change in the STRATCOM technique and operational practice; the panacea of this requirement developed into the STRATCOM MEX.

The first factor revolved around the modernization of the STRATCOM Channel and Technical Control Facility (CTCF). This facility provides circuit control and coordination on a global scale. The CTCF is the centralized agency within each STRATCOM station designed to perform the function of circuit control and coordination among forty STRATCOM stations that encompass the STRATCOM System. Figure 1 shows the Channel and Technical Control Facility at Andrews Air Force Base, Washington, D. C., and it is representative of the type of CTCF presently in use within the STRATCOM System.

One of the first steps in modernizing the Air Force CTCF's was to provide adequate test equipment. This was accomplished during the year 1956 under Project Double Check. Concurrently with Project Double Check, quality standards were developed by Airways and Air Communications Service (AACS) to insure circuit quality.[2] The test equipments provided by Project Double Check are adequate but cumbersome. Although these equipments are also used in industry, their intent and design is to provide "after the fact" information. A technician today, using these test equipments, is always looking for the trouble after it occurs.

While Project Double Check was phasing in, on-call patching service increased. On-call patching is a service provided by the CTCF over AIRCOMNET. This service provides a temporary trunk circuit between two distant terminals through a combination of circuits and channels connected by mechanical or electronic means. On-call patching makes a teletypewriter switchboard operator out of the channel and technical controller and a switchboard out of his DC patch panels. The fact is, on-call patching has become so time consuming that it prevents the channel and technical controller from making optimum use of the test equipment provided by Project Double Check.

The second related factor was the implementation of voice channel operation by the Air Force on single sideband and forward scatter circuits. The implementation of these circuits created the problem of terminating these channels in a manner which would provide maximum flexibility of service to authorized users. To resolve this problem, voice channels were terminated on base switchboards where the service was required. Although specific termination instructions and circuit quality standards were given to major air commands, the technical limitations of existing equipment used for termination and switching resulted in unacceptable service and created new problems.

It can be readily seen that an operational requirement existed to remove the teletypewriter patching requirements from the channel and technical control facilities and to remove the voice switching from the base switchboards. Both of these requirements were met by the development of the MEX facility.

The MEX facility is being implemented by means of a three-phase program. Phase I is manual, that is, a TWX type switchboard and a radiotelephone PBX type switchboard will be installed in major STRATCOM stations. Phase II is automatic switching within the Air Force. In this phase most of the manual MEX facilities will be phased out of major STRATCOM stations and be replaced by an automatic switching device activated by the subscriber; however, the manual MEX switchboards will be relocated at minor STRATCOM stations. Phase III expands the Air Force automatic MEX facility and incorporates commercial and governmental linkage.

Of the three MEX phases, only Phase I is presently in the development stage. The combined audio and DC switchboards have been given the nomenclature Central Office, Telephone-Teletypewriter AN/GSC-2. The audio segment is capable of handling voice and/or facsimile circuits and the DC segment is capable of handling teletypewriter and/or transceiver data link circuits.

The first three manual MEX facilities will be operational at Andrews Air Force Base in Washington, D. C., Sidi Slimane Air Base, French Morocco, and in Wheelus Air Base, Libia, during fiscal year 1959. These AN/GSC-2 units will be the prototypes; upon completion of an operational suitability test, seventeen additional AN/GSC-2 units will be installed in various Air Force bases throughout the world. These seventeen AN/GSC-2 units will be modified according to the results of the operational suitability test.

Concurrently with the implementation of the manual MEX facilities, automatic electronic quality control of the STRAT-

[1]Air Force Manual 1-2 entitled: *United States Air Force Basic Doctrine*, dated 1 April 1955, 10 pp.

[2]Richards, Maxwell J., Captain USAF, Quality Control of the STRATCOM System, SIGNAL, November 1957, 17-19.

Figure 1—A typical STRATCOM channel and technical control facility. Figure 2—Electronic quality and continuity control concept for the printed information media. Figure 3—Artist concept of the MEX facility. Figure 4—A position of the Bell System #5 switchboard. Figure 5—A Bell System switchboard for teletypewriter exchange service. Figure 6—A bay of 200 point Bell System crossbar switches.

COM System will be implemented. Although automatic electronic audio quality control equipment must be custom developed, the equipment to provide electronic quality control of the printed information channels is already in existence and procurement has been initiated. Figure 2 illustrates how the printed information channels between any two STRATCOM stations will be quality controlled. In a previous article, this author provided the quality standards that would be used to provide the required circuit quality.[3] It is envisioned that the alarm systems of all the automatic electronic quality and continuity control units, which will be installed within the STRATCOM channel and technical control facilities, will activate fault location equipment to be developed for the STRATCOM transmitter and receiver plants. In this way a potential circuit trouble will immediately become known and located.

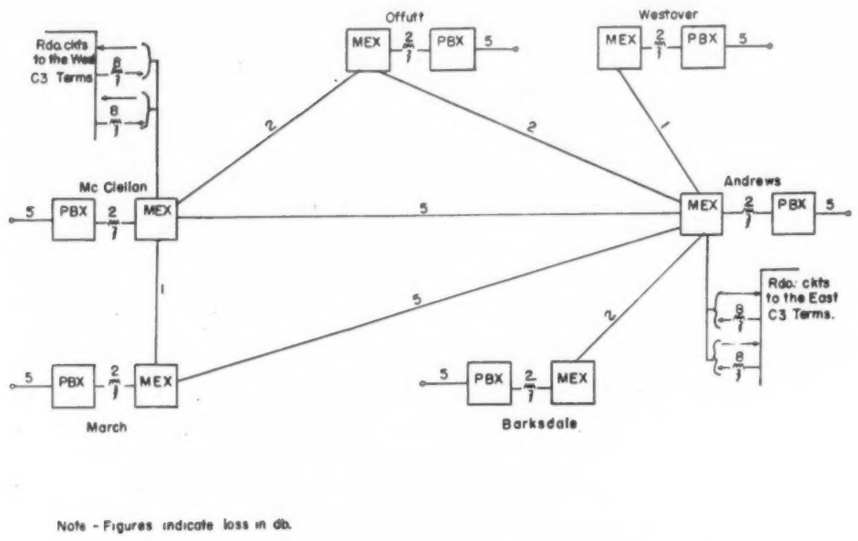

Figure 7. Voice quality to be used for the United States segment of the STRATCOM System.

As soon as the MEX concept became known within Airways and Air Communications Service, cartoons depicting the artists' versions began to circulate. Figure 3 is the cartoon that achieved the greatest publicity. Although the artist depicts the manual MEX as a simple looking device with a dial, it is actually two custom built four-wire switchboards: an audio switchboard and a teletypewriter switchboard. Figure 4 depicts a typical Bell System toll switchboard position showing double plugs and double jacks and illustrates the audio segment of the AN/GSC-2. Figure 5 depicts a Bell System teletype exchange switchboard position and illustrates the teletypewriter segment of the AN/GSC-2. When the manual MEX is replaced by an automatic facility, it is envisioned that the typical 200-point crossbar switches depicted in Figure 6 will replace both of the aforementioned switchboards.[4]

[3]Richards, Maxwell J., *op. cit.*

[4]Figures 4, 5 and 6 were provided to this author by the Bell System expressly for this article through the efforts of Mr. Wendle E. Lind, Washington, D. C. office of A. T. & T.

When considering the design of the AN/GSC-2, the Air Force used a modification of the Signal Corps Cost Reduction Program.[5] The Signal Corps requests manufacturers of developing equipment to make an engineering cost analysis of development models and to point out those features of the design which would involve abnormally high production costs. Upon receipt of such reports, a compromise is then sought between the attainment of lower production costs on one hand and the retention of optimum design and performance characteristics on the other hand. The Air Force modification of this program was to have the design engineers sit at an informal conference with Air Force engineers and Air Force operations officers. In this way the Air Force expedited the program and accomplished the desired results.

Concurrently with the designer/Air Force conferences,

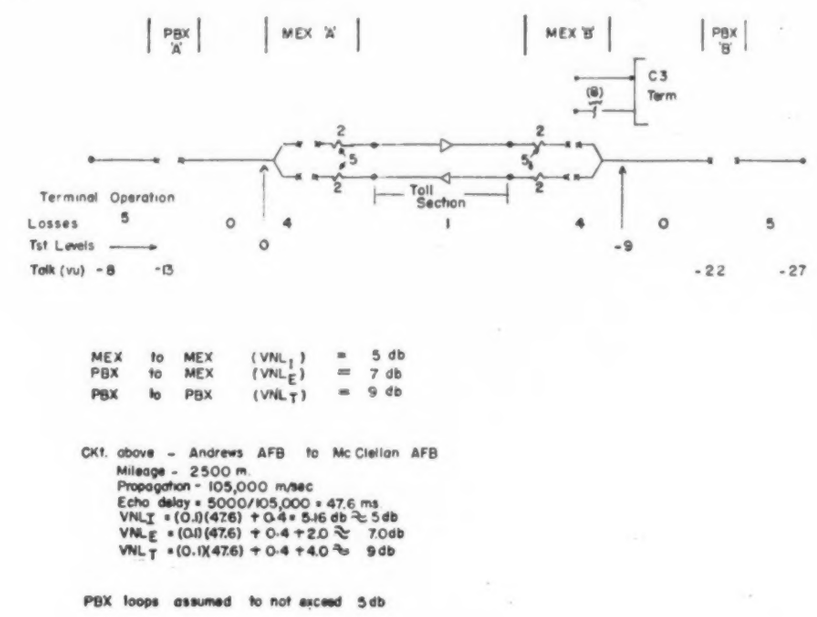
PBX 'A'
MEX 'A'
MEX 'B'
PBX 'B'
C3 Term
Toll Section
Terminal Operation
Losses
Tst Levels
Talk (vu)
MEX to MEX (VNL I) = 5 db
PBX to MEX (VNL E) = 7 db
PBX to PBX (VNL T) = 9 db
CKt. above - Andrews AFB to Mc Clellan AFB
Mileage - 2500 m.
Propagation - 105,000 m/sec
Echo delay = 5000/105,000 = 47.6 ms
VNL I = (0.1)(47.6) + 0.4 = 5.16 db ≈ 5 db
VNL E = (0.1)(47.6) + 0.4 + 2.0 ≈ 7.0db
VNL T = (0.1)(47.6) + 0.4 + 4.0 ≈ 9db
PBX loops assumed to not exceed 5 db

Figure 8. Subscriber to subscriber voice quality to be used by the STRATCOM MEX.

other conferences were held with the Bell System to establish the quality of the voice landlines to be used when the AN/GSC-2 phases in. This was a basic requirement because the audio landlines used within the United States segment of the STRATCOM System are provided by the Bell System. Figure 7 and 8 illustrate the voice quality to be used when the first of the MEX phases is implemented into the STRATCOM System.

From a relatively simple piece of equipment, the AN/GSC-2, the Air Force is modifying its STRATCOM System so that a subscriber anywhere in the world, whether or not airborne, will have the capability of dialing a code and obtaining an automatic connection with the called subscriber for immediate transmission of information over the media selected. In this way the STRATCOM System will meet the flexibility requirements generated by the missile age and will provide the flexibility required to support missiles of even greater performance capability which may be developed in the foreseeable future.

[5]Back, G. I., Major General, USA, Communications and Electronics in the Army, SIGNAL, January 1953, 20-22;66.

To Our Exhibitors and Advertisers

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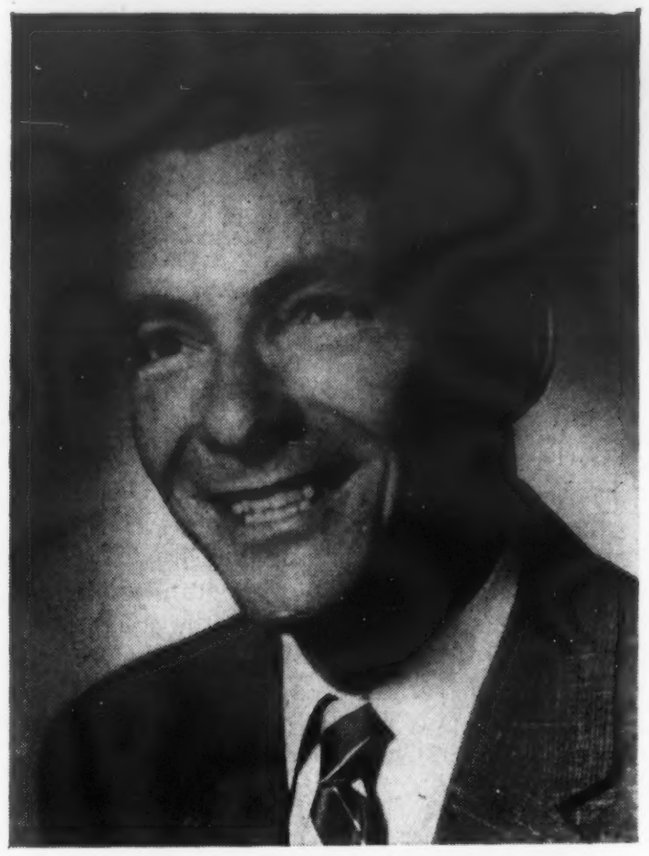

IRE always remembers the man. *This year IRE honors Charles P. Ginsburg with the Vladimir K. Zworykin Television Prize Award for his contributions to the development of video magnetic recording which makes possible instantaneous rebroadcasting with sharp, clear pictures. This and all other advances toward man's future made better by radio electronics is part of a history recorded and promulgated by* **The Institute of Radio Engineers.**

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photoprogress

by FRANK SMITH
SIGNAL PHOTO EDITOR

"Flash-Processed" Oscillograph Records

A revolutionary new concept in oscillography furnishes a completely developed and dried oscillogram on standard papers in less than one second for examination and use in full daylight. It is made possible by a new direct-writing magazine which attaches to standard oscillographs. Called the 5-036 Datarite Magazine, the magazine imparts new versatility to the use of conventional silver-halide emulsion recording papers. With a nominal capacity of 400 ft. of 12-inch paper, the unit provides high-information capacity for long recording runs.

The unit performs three separate operations almost simultaneously. These are exposure of the silver-halide emulsion to the input signals; application of a thin film of developer to the emulsion side only of the record, and application of heat. Following these rapid operations, the record is fed continuously from the magazine.

During application of the developer, only enough liquid is applied to wet the emulsion layer. Several important advantages are realized from applying the developer thinly to wet only the gelatin emulsion and not the paper base. First, the amount of moisture to be evaporated in the drying stage is minimized. Second, staining of the record by developer residues is practically eliminated. Finally, distortion of the record, which would result from wetting and drying of the paper base, is practically eliminated.

The method of applying heat to the paper during the developing process is another feature of the unit. This is accomplished by drawing the paper over a stationary platen which is automatically maintained at the correct temperature. Two 500-watt heaters not only dry the record, but they accelerate action of the developer so that the record is fully developed in as little as 50 milliseconds. Practically any silver-halide emulsion can be used in the unit.

The unit is operated from any 115-volt, 60-cycle power source and it measures 15½" x 13" x 11¼" and weighs 55 pounds when fully loaded with developer solution and a 400 ft. roll of paper. The unit is a product of Consolidated Electrodynamics Corp., Pasadena, Calif.

Instantaneous Visible Images Without Chemical Processing

It is well known that in giving up photographic development, one sacrifices an energy amplification factor of enormous power. This is exactly what has been done in the case of Kodak's new Linagraph Direct Print Paper which is a print-out material providing an immediately visible record without the intervention of chemical processing.

With this paper, exposure to a high intensity mercury vapor ultra-violet point source is usually sufficient for a legible record. Where it isn't, a post-exposure to some 60 foot-candles from a fluorescent lamp will raise the speed several hundred times. The oscillographic trace comes out blue on a buff background.

The new photo-recording material may be used in conjunction with several new special type moving-mirror galvanometer oscillographs and it should find wide application for immediate read-out of test results in the missiles and aircraft field, in oil exploration, in automative, medical, nuclear and many other control, production and computing operations.

When multiple work prints of the original records are desired, intermediates may be made on Kodagraph Autopositive materials for use in direct process reproduction.

Pen or pencil notations may be made on the new paper's surface as desired. While records on the new Direct Print Paper maintain their sharpness and legibility adequately, a high degree of permanence may be obtained by chemically fixing the paper employing conventional photographic means.

Although there are no direct relationships between the print-out and developing-out systems, it can be stated, however, that Linagraph paper is approximately 1/75 the speed of Velox 2 paper, when sufficient UV intensity is employed to produce a visible image during the initial exposure. When a secondary exposure is used to "develop" the latent image, the speed is approximately that of a Kodabromide paper.

Additional information may be obtained from Graphic Reproduction Sales Division, Eastman Kodak Co., Rochester 4, New York.

Slide-O-Film—A New Heat Developable Film

One of the hottest items announced recently is Slide-O-Film, a new photosensitive material manufactured by the Charles Beseler Co., 219 South 18th Street, East Orange, N. J., the outstanding features of which are that it is grainless, and is developed by heat.

The new material requires no chemicals or darkroom and requires only a minute for development.

The film represents a radical departure in photosensitive materials from the conventional silver halide systems since it contains no silver. Since the material contains no silver in any form, it is free of grain so that, as a result, copies can be made with higher resolution than available in the finest existing fine grain material. The film embodies a physical system of photography that does not require a chemical process. It is a system which works by photographic production of light-scattering centers in its surface structure, rather than by light absorbing grains as in conventional photographic systems. Exposure is by ultraviolet and the film is not sensitive to ordinary room light.

The film is especially desirable for making black/white negatives from color slides; projection positives from these black/white negatives, and black/white positive projection transparencies from any black/white negative.

Heat development is accomplished at any temperature between 200°F and 260°F, a common source being an ordinary flat iron or even immersing in boiling water. The company is introducing a compact Slide-O-Film Printer to retail for approximately $25.00. It will incorporate in one compact unit a convenient exposure frame with two built-in ultraviolet lights, an automatic timer, and a thermal roll which provides an exact measurement of heat for proper development.

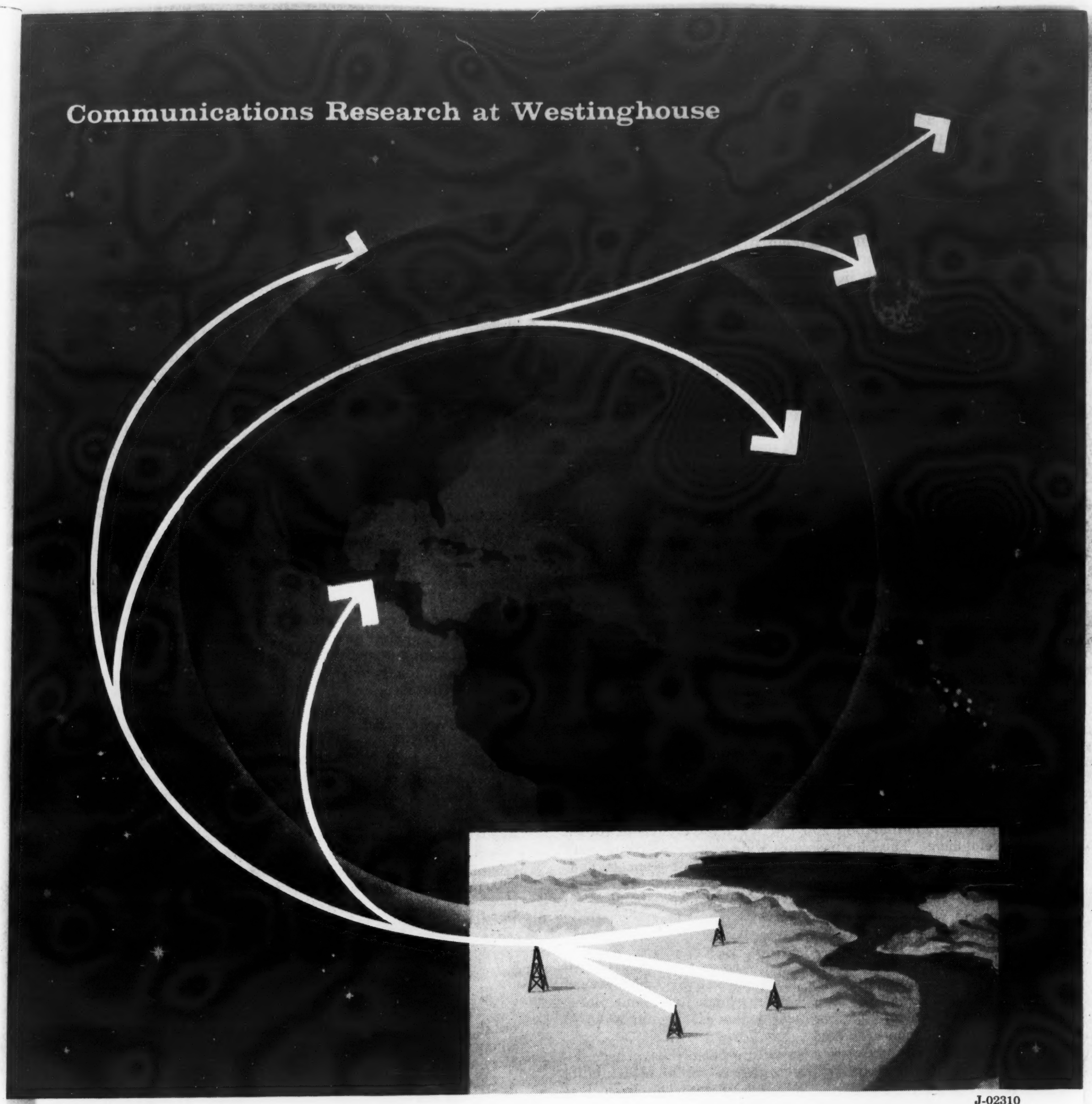
The base of Slide-O-Film is mylar which is tear resistant and dimensionally stable and the image is non-fugitive. The film is available in 35mm 36-exposure rolls and in 2¼" x 2¼" 24-sheet packs.

Duplication of Polaroid Prints In Camera

One of the minor disadvantages of the Polaroid-Land "picture-in-a-minute" Camera is the difficulty of duplicating prints. With the invention of Waldemar A. Ayres at Fort Lauderdale, Florida, camera users all over the world will now be able to take a photograph and then immediately make all the duplicate positive prints they want in the camera, without any darkroom.

According to the inventor, for the first time in photographic history it will be possible for one to take a photo-

(*Continued on page* 78)



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graph, develop it to produce a positive print immediately in the camera, and then put this positive print back in the camera as a "master picture" and, from it, make as many duplicate prints as are required on the spot, one after another, using additional portions of unexposed film in the camera for the purpose.

To demonstrate the principles of the invention, Mr. Ayres built the new mechanism into the widely used Polaroid-Land self-developing camera. With this device, it will be possible now to take the picture, develop it in 60 seconds, coat it, let it dry for five minutes (Polaroid's standard instructions), and then put it back in the camera so as to make as many duplicate positive prints as required, using an exposure of a few seconds and the standard developing of 60 seconds apiece. The procedure is extremely simple and no new technical or special knowledge is needed.

Mr. Ayres' invention consists of making a light-trapped slot in the back of the camera into which a special holder fits. In the duplicating operation the print which one desires to duplicate is placed into this special holder and the holder is then inserted into the camera back through the slot. The camera lens then is exposed to a source of light which causes the print to be duplicated on the film contained in the camera. In effect, the camera is used as a contact printer with the exposing light coming through the camera lens.

The invention has also been used successfully to make black/white duplicate prints from color transparencies and also color opaque prints without waiting and at reduced cost.

Film Speed Up to 1000 and Higher

Super Hypan, a new finer grain, super-speed black/white film, is now available in 120-, 620- and 20-exposure 35mm sizes, according to an announcement from Ansco, Binghamton, N. Y.

Although Super Hypan film has an official exposure index of 500 daylight and 400 tungsten, it may be exposed at indexes up to 1000 daylight and 800 tungsten or higher. This speed flexibility makes the new film ideal for all types of picture taking—low-level, existing light candids, scenics, portraits and stop-action photography. The film combines exceptional speed with smooth fine grain, excellent definition, panchromatic sensitivity, graduation control through processing manipulation and low fog level even with forced development. The film possesses wide exposure latitude and tolerates over and under exposure up to two stops without noticeable loss of print quality.

Super Hypan film is also available in professional sheet film and 70mm sizes.

The New Super Graphic 45

Users the world over of this well-known press camera will be glad to know that Graflex has come out with an improved model of their famous press camera which just about places it out of this world (camera world, that is) insofar as press cameras are concerned.

For the first time, several new movements have been incorporated in the camera which assures complete flexibility to adjust composition and depth of field. The front lens standard tilts forward and back, swings right and left, and rises and shifts right and left. The forward lens board and drop bed combine for a 30-degree tilt. The drop bed also accommodates wide-angle lenses.

The lateral swing of the lens board can be used in combination with all other tilts, swings and shifts to correct optical distortion, parallelism and composition. The camera is equipped with revolving back for horizontal and vertical positions, and it permits film holders to be inserted from top, bottom, right or left—a convenience for many left-handed photographers.

Electric shutter and flash tripping is provided by a button located conveniently to operate built-in BC circuit with self-contained batteries. Automatic focusing scale to match any lens you use on the camera is located conveniently on top of the camera.

A new style double cam action slide lock holds any accessory for Graphic or Graflok back. One may slide off the focusing panel and attach the Grafmatic sheet film magazine, roll film holder, film pack adapter, Polaroid back or Graflarger. The accessories become part of the revolving back.

The body of the camera is made of extruded aluminum and the weight is 4¾ lbs. The camera produces 4 x 5 negatives and, when equipped with a Kodak Ektar 127mm f/4.7 lens and No. 1 Graphic synchronized shutter, is listed at $367.50.

Rolleiflex 4 x 4 Cm Miniature Reflex Camera

Rolleiflex enthusiasts will welcome the news that after a period of some 17 years, Franke and Heidecke of Braunschweig, Germany, are again manufacturing their miniature 4 x 4 Cm (1⅝" x 1⅝") Rolleiflex which was discontinued in 1941 due to the war.

The 4 x 4 Cm Rolleiflex is a true miniature camera, taking into account its format and focal length. In picture area, however, it is halfway between the classic Rolleiflex 6 x 6 cm (2¼" x 2¼") format and the Rolleikin 24 x 36mm (1" x 1½") format. Its full area (41 x 41mm) is approximately half of that of the 6 x 6 Cm camera and almost double the normal 24 x 36mm format (actually 95% increase). Because of this, the miniature captures more fine detail and offers the greatest possibility for extreme enlargements from miniature negatives.

A feature of the miniature Rolleiflex is that the same lens accessories (size I), with the exception of the lens hood, which fit the bayonets of the 6 x 6 CM Rolleis with Xenar, Tessar and Triotar 3.5 can be used. This feature means that owners of both camera models will need only a single set of accessories.

The camera uses the popular size No. 127 film which yields twelve 4 x 4 Cm pictures. Additionally, the camera is equipped with automatic film transport and Synchro Compur shutter with ten speeds from 1/500-1 sec., an X-M contact for electronic flash and flash bulbs and built-in sports finder for direct observation of fast moving objects, and is normally furnished with a Scheneider Xenar f/3.5 lens.

Dimensions of the miniature Rolleiflex are 4¾" x 2½" x 3¼". The weight is 24 oz. and is listed at $133.65. A full line of accessories is available. The American distributor for the miniature is Burleigh Brooks, Inc., 10 West 46th St., New York 36, N. Y.

Argus Cameras Introduces New C-44 Color-Slide Camera

A new Argus C-44 color-slide camera with rapid wind and rewind controls for swift, convenient film movement, and selective turret viewfinder for exact multi-lens viewing has been announced by the Argus Cameras Division of Sylvania Electric Products, Inc.

The rapid wind lever on top of the camera is precisely positioned for smooth, efficient operation. Two quick thumb strokes advance the film for the next picture, automatically cocking the camera's shutter. Rewinding of exposed film is accomplished briefly and easily with a unique rapid rewind crank which is lodged within the rewind knob—its position when not in use. The crank pops out, ready for use, when a button on top of the knob is pressed.

Through simple rotation of the turret viewfinder mounted on top of camera, a completely separate "true-image" optical system is selected for each of the popular C-44 interchangeable lenses—the 50mm standard, 35 mm wide angle and 100mm telephoto lens.

List price for the New C-44 is $99.95 while the Argus turret viewfinder, which can be used on any Argus camera equipped with an accessory shoe, is priced at $24.95.

Flash Development, "Futuramic" Strobonar

Sooner or later it had to come—a transistorized electronic flash without bothersome power packs!

Called the "Futuramic" Strobonar, the completely self-contained unit operates from three photoflash batteries or from ordinary AC if required. The new Eveready E95D batteries give over 500 flashes in the transistor model (Futuramic Strobonar 64-B) and 250 flashes in the Standard Model (64-A). Ordinary photoflash batteries give 200 and 100 flashes respectively. Heiland Permaclad permanent, rechargeable nickel cadmium D-cells may also be used.

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Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

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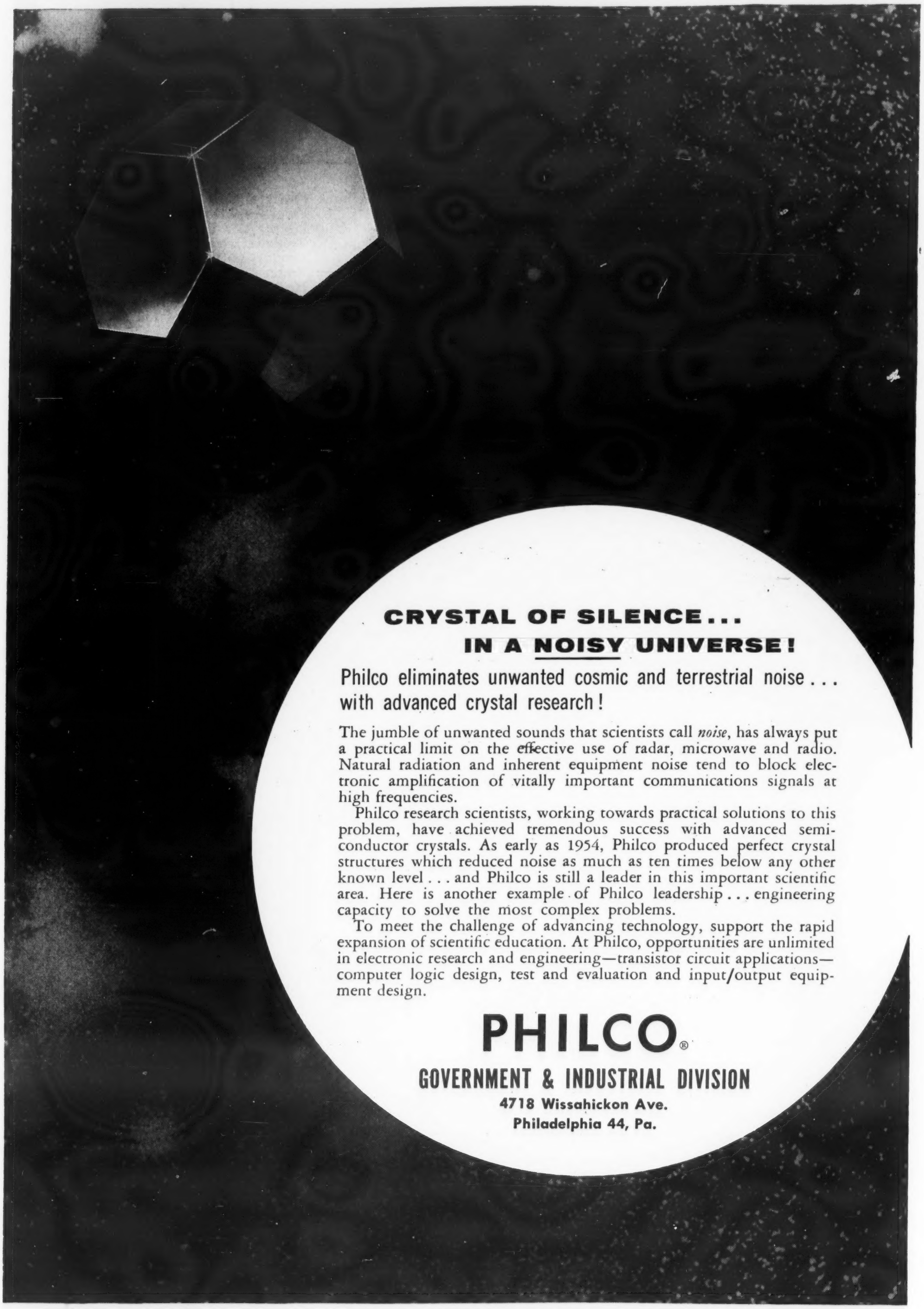

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Chapter News

Arizona

Man's first research vehicle to leave the earth in 1783 is now the most economical and one of the most promising methods. So stated Ralph D. Reynolds and Roy E. Sandlin of Holloman Air Force Base, New Mexico, who presented a comprehensive story of high altitude research at the March 18th chapter meeting held at Fort Huachuca.

Holloman Air Force Base contains the largest balloon testing agency in the free world. Balloons are used as test vehicles because they are so much cheaper than rockets to explore the higher atmosphere; all the Armed Forces utilize this facility as well as many contractors and other research and test organizations.

Experimental parachute jumps have been made from high altitudes in order to determine design criteria for the oxygen supply which a pilot must have to live, type of clothing, suitable parachutes, etc. Dummies are first used, then men. Bailouts are planned up to 100,000 feet, or about 20 miles.

Even on unmanned balloon flights an instrument capsule is carried aloft to photograph and record information necessary for space travel, weather predicting, cosmic radiation, infrared radiation, etc. Other planets are photographed from above the earth's atmosphere. Also a small radio transmitter is carried in this capsule which continually transmits additional data to earth as the balloon ascends and travels away. By means of radio control from the ground this capsule is released from the balloon and parachuted down to earth. Every effort is made to recover these capsules, and 90% are actually found. They are reconditioned, modified and used over and over as the research program progresses.

Atlanta—Newly elected President W. B. Bryan (left) and Lt. Col. Donald L. Adams, past president, chat with Rear Adm. H. C. Bruton, Director of Naval Communications, principal speaker at the March 18th chapter meeting.

Radio control from the earth consists of ballast release, gas release, as well as parachute release. Radar equipment at Holloman Air Force Base is used to track all balloons and, to expedite this tracking, a small metal corner reflector is carried aloft under the instrumentation capsule.

Chapter officers and directors met with Executive Vice President W. B. Goulett on April 11th for a conference on chapter matters. Those in attendance were: Arthur H. Mudgett, president; Lt. Col. Leonard F. Walker, vice-president; Dr. James C. Coe, secretary-treasurer; Col. Edmund T. Bullock, William S. Marks and Forrest G. Hogg, directors, and Lt. Col. Walter D. Lundy, co-chairman of the membership committee.

Atlanta

Named to the board of directors for 1958-59 were: Lt. Col. Donald L. Adams, Third U. S. Army Headquarters; Col. Kirk Buchak, Third U. S. Army; A. J. Cartey, Southern Bell Tel. & Tel. Co.; Capt. Jesse Draper, USN (Ret.), Draper-Owens Co.; Ben S. Gilmer, Southern Bell Tel. & Tel. Co.; W. L. Mollands, Stromberg-Carlson Co.; W. Kelly Mosley, Southern Bell Tel. & Tel. Co.; John E. Ramsey, Philco

Boston—Chapter officers are given a preview by Charles W. Creaser, Jr., of his talk at the March 13th meeting. Mr. Creaser and R. J. Grenzeback, at his right, are vice presidents of the D. S. Kennedy Co., manufacturers of large antenna systems. From left to right are: Capt. A. R. Taylor, USN(Ret.), program chairman; Frank Lyman, Jr., vice president; Messrs. Grenzeback and Creaser; Raymond B. Meader, director; Col. Murray D. Harris, president, and Robert B. Richmond, president-elect.

Fort Monmouth—Shown during the April 17th meeting are, left to right: Lloyd Christianson, president of Electronic Associates; Col. A. T. Stanwix-Hay, CO, USASESA; Olaf Fernald, Westinghouse Electric Co. guest speaker; Chapter President Halsey Hubbard, and Lt. Col. Patrick H. Meehan, Dep. Cmdr., USASESA.

Corp.; John S. Seigle, Southern Bell Tel. & Tel. Co.; R. J. Smith, Atlanta General Depot.

The following committee chairmen have been appointed for the new year: Reception—M. S. Butler, Southern Bell Tel. & Tel. Co.; Civil Defense—J. S. Bonner, Southern Bell Tel. & Tel. Co.; House—Capt. N. A. Christensen, Third U. S. Army Headquarters; Membership—W. G. Burnett, Southern Bell Tel. & Tel. Co.; Program—A. J. Cartey, Southern Bell Tel. & Tel. Co.; Publicity—H. C. Malone, Jr., Southern Bell Tel. & Tel. Co.

A. M. Wilson of Southern Bell Tel. & Tel. Co., 1957-58 secretary-treasurer, was appointed for another term.

Augusta-Fort Gordon

The chapter's April 17th dinner-meeting was addressed by Louis Harris, Executive News Editor of the *Augusta Herald and Chronicle*. His talk covered his experiences during a recent visit to Japan.

Dinner and a social hour preceded the meeting at Timmerman's in Augusta.

Boston

The chapter's annual meeting was held at the Charlestown Naval Shipyard on March 13th. Approximately 60 members were present in the Commander's conference room, following a social hour and dinner in the Commissioned Officers Mess.

New 1958-59 chapter officers were elected as follows: president—Robert B. Richmond, New England District Manager, General Radio Company; vice-presidents—Frank Lyman, Jr., President of Cambridge Thermionics Corporation, and Louis J. Dunham, Jr., Director, Franklin Technical Institute; secretary—William Melanson, Cambridge Thermionics Corporation, and treasurer—Vernon T. Adams, Western Union Telegraph Company.

Directors elected were: Col. M. D. Harris, PMST, Northeastern University; Capt. D. R. Hull (USN) Ret., Raytheon Manufacturing Company; Capt. Raymond B. Meader (USNR), New England Telephone and Telegraph Co., and Fred E. Moran, Western Union Telegraph Company—all former presidents of the chapter.

President Harris, who received a standing vote of thanks for his work during the current year, reported the following facts: officers, directors and committee chairmen have met at least bi-monthly throughout the past year in order to conduct chapter business; chapter constitution and by-laws have been revised; chapter organization and procedures have been reviewed and strengthened; committees have been reactivated and restaffed; a membership campaign has been started.

Appreciation was expressed for the loyal and effective work of officers and directors and the following committee chairmen: Program—Capt. A. R. Taylor, USN (Ret.); Reception—William Holdich, Boston Naval Shipyard; Publicity—Jack Hobby, Raytheon Manufacturing Company; Membership—E. R. Chasson, New England Telephone and Telegraph Company; Finance—Frank Lyman, Jr.; Liaison—Lt. Col. Fred J. Frank, Assistant PMST at Northeastern University, who also is adviser to the Northeastern Student Chapter.

Speaker of the evening was Charles W. Creaser, Vice President, D. S. Kennedy Company. He gave a talk concerning the work of the Kennedy Company and showed a number of slides of unusual antennas constructed by his company all over the world. The talk was closed by a projection of the "perfect antenna: carved out of a mountain of solid marble; gold-plated, 'perfect' reflecting surface; constructed with balloon-suspended feed system to reduce aperture-blocking!"

Decatur

Four electronics courses are being conducted by the chapter. They are: AC-DC Theory; Electron Tubes; Radio Transmitters & Receivers, and Television Receivers.

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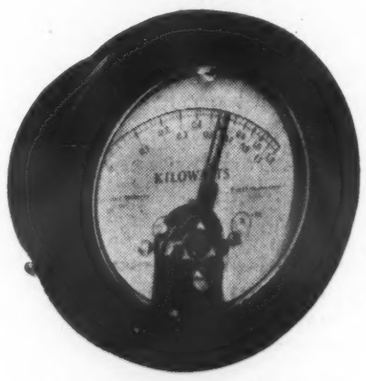

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Shock test: Total of 18 impact shocks of 15 G's.

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Vibration: Survives 10-55-10 cps, .060 amplitude, 1 minute cycle, 1 hour, 3 axes.

Corrosion: Passes 50 hour salt spray (QQ-M-151a).

Contacts: Rated 100 Ma, insulation to signal coil rated 300 volts DC.

Description: Has a set of contacts in series with locking coil. Signal and locking coil, both on moving structure, lock pointer contacts positively. Resets when contact circuit is interrupted.

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In the past, the chapter has trained about 125 students in these fields. Currently, they are conducting five classes per week, evenings, Monday through Friday, with 120 students in attendance.

Fort Monmouth

The subject of the April 17th meeting was color television, with Olaf Fernald, Supervisor of Color Television Engineering, Westinghouse Electric Corporation, conducting the program.

In his demonstration, Mr. Fernald used three 35mm projectors for effective blending of color and also had three 21" color television sets in operation during his talk.

The nominating committee, headed by J. P. Hoffman, Post Information Officer, submitted its report on a slate of candidates for new officers of the chapter preparatory to the annual election to be held in May.

Louisiana

Chapter members met on April 17th at the Coast Guard Commissioned Officers Mess on the lake front. A friendship hour and dinner preceded the meeting.

Guest speaker was R. Frank Thomas, branch manager, International Business Machines Corporation, who presented a timely program on "Man in Space."

New York

The role of the ground forces in the "Strategy of the Missile Age" was presented by Major General John C. Oakes at the March 26th meeting. General Oakes, in his capacity as Assistant Deputy Chief of Staff for Military Operations, Department of the Army, was particularly well qualified to discuss this timely and thought-provoking subject. The meeting was the second in a continuing series devoted to an examination of the roles of the various Services in our modern defense strategy.

General Oakes introduced his subject with the premise that the unrestricted use of nuclear weapons would result in mutual disaster. Based upon this and other premises, General Oakes indicated that we must have the capability of waging limited wars with limited objectives with the employment of limited means of warfare.

New York—Maj. Gen. John C. Oakes, Asst. Deputy Chief of Staff for Military Operations, Department of the Army, was the guest speaker at the March 26th meeting. Above, left to right, are: Col. Ludwig Engler, chapter president; General Oakes; Vice Adm. Walter S. Anderson, a former president of the chapter, and Col. Joseph E. Heinrich, National Vice Pres.

We must, stated General Oakes, create a military posture which will facilitate our foreign policy objectives through a forward looking military strategy. Our military strategy, in implementing a flexible foreign policy, requires a balance between strategic and deterrent forces. The mission and employment of deterrent forces was then explained.

General Oakes' talk was well received by the chapter. The interest in his subject was evidenced by an exceptionally large turn-out.

North Carolina

At the March 26th meeting, the following committees were appointed by President James Fowler: Membership Committee—Col. Ray Bagley, chairman, Ft. Bragg; J. K. Avent, Carolina Tel. & Tel. Co.; W. Thomas Edwards, Southern Bell Tel. & Tel. Co.; Program Committee—Col. James R. Miller, co-chairman, Post Signal Section, Ft. Bragg; Thornton W. Rose, co-chairman, Carolina Tel. & Tel. Co.; A. L. Taylor, Carolina Tel. & Tel. Co.; Lt. Col. Eugene L. Weeks, Ft. Bragg; Finance Committee—T. P. Williamson, chairman, Carolina Tel. & Tel. Co.; J. C. Coley, Carolina Tel. & Tel. Co.; Major Warren S. Bell, Ft. Bragg.

The program feature of the meeting was the Army film entitled "The Pentomic Army."

North Texas

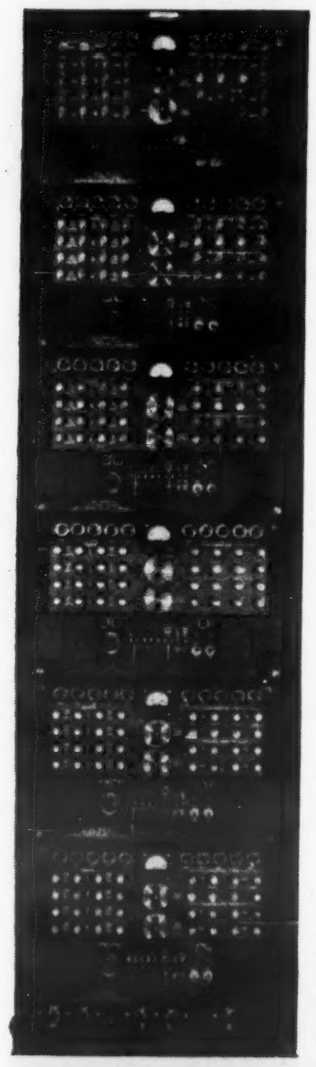
Chapter members and guests enjoyed a cocktail hour and dinner at a meeting held at the Glass House Restaurant on April 16th in honor of Executive Vice President W. B. Goulett. Chapter President H. J. Wissemann of Texas Instruments, Inc., presided.

In addressing the members, Captain Goulett brought out some of the highlights of the national program and, on the local level, discussed means of stimulating chapter growth and interest.

Northeastern University

The following program of chapter activities was scheduled for the spring term:

April 9th—Introduction of new officers and members and business meeting. Organization of committees—electronics, communications, photo and en-



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These systems provide a voice-channel flat within 1 db from 300 to 3500 cycles, for each 4 kc of bandwidth occupied. Each channel is equipped with hybrid, signalling, and dialling circuits for all the standard 2-wire and 4-wire loop options.

The basic unit provides an order-wire and 4 carrier-derived channels. These units can be stacked in groups of 2, 3, 4 or 5 by means of a group modem to provide 9, 14, 19 or 24 channels. Full flexibility is provided for dropping and inserting channel groups at repeater and terminal points. Moderate lengths of 4-wire cable or open-wire line may be inserted between the multiplex equipment and the radio terminals.

24-channel carrier-telephone terminal complete with hybrids, ringing and dialling circuits, and test facilities. Dimensions are 58" high, 16" wide and 8" deep. Power input 250 watts. Weight 326 lbs.

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JUNE, 1958

North Carolina (photo at right)—Pictured at the March meeting at Fort Bragg are, left to right: J. B. Teal, Defense Coordinator, North Carolina T&T Co.; E. M. Veale, Defense Coordinator, Southern Bell T&T Co.; and Thomas Peale, Superintendent of the Fort Bragg telephone plant operated by the Signal Corps. ***Northeastern University*** (below)—On the right, Col. M. D. Harris, PMST at Northeastern and president of the Boston Chapter, congratulates Cadet 2d Lt. Leonard Y. Lewis, newly elected president of Div. B of the Northeastern University Student Chapter. In the back row, left to right, are: Cadet Richard Garvin, treasurer; Harold Giberson, vice president; Cadet 2d Lt. John Barros, secretary, and Lt. Col. Fred J. Frank, faculty advisor.

tertainment. Film: "Science in the Signal Corps." April 16th—Lecture: "Scatter Communications" presented by Tom Rogers of Cambridge Air Force Research Center. April 23rd—Lecture: illustrated talk, "Color Slide Photography:" types of color film, composition and exposure. April 30th—Field trip: Air Control Center at Logan International Airport. May 7th—Field trip: visit to Boston Naval Shipyard to board combat vessel. May 9th—Joint Division A & B dinner at Charlestown Navy Yard. May 14th—Lecture: communication problems in the Pentomic Army. May 21st—Field trip: tour of Boston Harbor on harbor craft. May 28th—Film: preview of "The Northeastern Story" produced by the student chapter. Preparations for convention. June 4th—Final meeting: plans for membership drive, next year's program, business meeting.

Philadelphia

Guest speaker at the April 2nd meeting, held at the Engineers Club, was E. B. Ferrell of the Bell Telephone Laboratories. His subject was "Recent Advances in Communications Research."

On April 14th, the chapter participated in a joint meeting of the IRE Communications Technical Division and the local section of the AIEE. Principal speaker was T. A. Smith, Executive Vice President, Industrial Electronics Products Division, RCA, who discussed "Communications—The Growing Servant of Industry." This meeting was also held at the Engineers Club.

Pittsburgh

Special arrangements were made by F. E. Leib of Copperweld Steel Company, chapter director and a former president, for a chapter tour of Duquesne Light's Atomic Power Station on April 17th. This power station has received nation-wide publicity and marked the first step in the United States in the actual use of atomic energy for power purposes.

The members rated the tour of the Shippingport Atomic Power Station as one of the most outstanding programs ever scheduled by the chapter.

Rocky Mountain

The January dinner-meeting was held at the Ent Air Force Base Officers Club on the 23rd. A technicolor film entitled "The Complete DEW Line Story," produced by the Bell Laboratories, was the program feature.

Fort Carson Officers Club was the scene of the February 20th gathering. Chapter members were given an interesting review of the Army's new atomic weapons organization by viewing the film "The Pentomic Army." A descriptive introduction to the film was presented by Major E. E. Ferguson, Signal Office, Fort Carson.

San Diego

This new chapter came into being at the organizational meeting held at the San Diego Civil Defense Headquarters on April 9th. Capt. W. B. Goulett, Executive Vice President, presented the official chapter charter.

Cdr. Samuel Freedman, USN (Ret.), General Manager of Chemalloy Electronics Corporation, who headed the organization committee, was elected president of the chapter. Other officers chosen were: secretary—Mrs. Dolores R. Stover, Western Union; treasurer—Cdr. Earl G. Schweizer, Staff Supply Officer, Commander Training Command, Pacific Fleet and Supply Officer, U. S. Fleet Sonar School.

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— by HUGHEY & PHILLIPS, INC.
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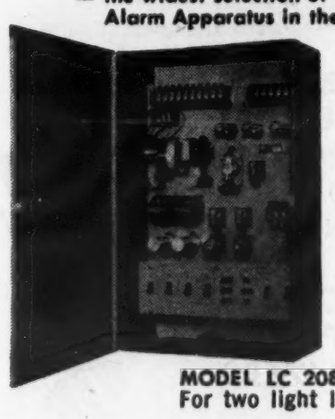

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For two light levels

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These units provide a separate signal for failure of each top lamp and include maintenance-test switches. Also available with photo-electric control for tower obstruction lights.

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BURBANK, CALIF.

Rocky Mountain—Pictured at a recent meeting, left to right, are: Col. O. W. Miller, USAF, chapter president; and Lt. Col. K. N. Keyte, vice president in charge of programs.

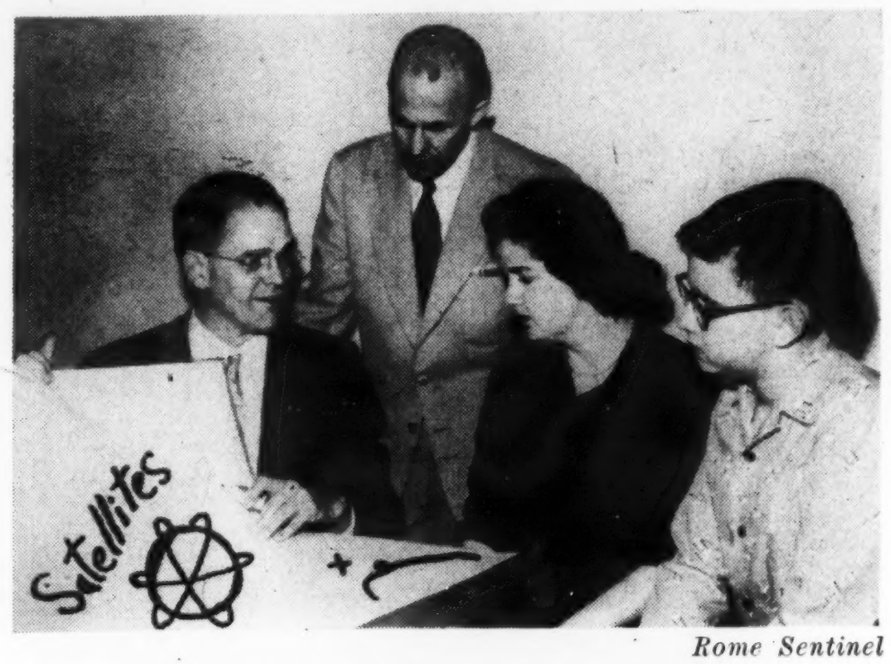
Scott-St. Louis—Head table of the April meeting—left to right: Col. William D. Paschall, Deputy Director, St. Louis Civil Defense Admin.; Rear Adm. Robert E. Melling, chapter director; Brig. Gen. F. P. Hardaway, Director, St. Louis CDA; Capt. George A. Cunningham, guest speaker; A. L. Lenny, and Maj. Gen. D. C. Doubleday, chapter directors.

Among the fifty members and prospective members present were some who came from as far as Laguna Mountain Air Force Station 50 miles away and La Jolla and Coronado some 20 miles distant. Those in attendance included representatives from the Air Force, Navy, Marine Corps, Western Union, Convair, Chamber of Commerce, Civil Defense, as well as numerous retired service personnel. Among those present were: Dean Howell, Chairman of the County Board of Supervisors; Capt. T. R. Kurtz on the staff of and representing Admiral Hartman, Commandant, 11th Naval District; Col. L. Wadsworth, head of the County Civil Defense, and Rear Adm. Stanley F. Patten, USN (Ret.), a former president of AFCEA's New York Chapter.

The evening's program was presented by the Civil Defense of the County of San Diego. Walter L. Chandler, Radiological Officer, described the work and planning of that organization, and Ben Hamilton, head of the County Civil Defense radio network, described the communication system. A British film on the H-bomb, and a guided tour of the communication facilities at the Civil Defense Headquarters building concluded the first program of AFCEA's San Diego Chapter.

The chapter plans to hold monthly meetings at varying locations to enable the maximum number of actual and potential members to attend. Its May meeting was scheduled for May 13th at the U. S. Navy Fleet Sonar School with a presentation on the subject of anti-submarine warfare.

Rome-Utica — Dr. Thomas T. Goldsmith, Jr., vice president in charge of engineering, Allen B. DuMont Laboratories, Inc., discussed satellites at the March meeting. Shown, left to right, are: Dr. Goldsmith; George Freeland, Rome Free Academy English teacher; Millie Mertens, chapter member; and Richard K. Hallmark, an eighth-grade student at Laurel Jr. High School, who was one of the students invited to attend the meeting.



Rome Sentinel

Scott-St. Louis

"Communications Requirements for a Nuclear Special Weapons Test" was outlined at the April 11th meeting.

Featured speaker was Captain George A. Cunningham of the 3310th TTGp, who related some of his experiences as Communications Officer assigned to the Special Weapon Center with operations at the Nevada Test Site and on Eniwetok during a recent four-year tour

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San Diego—Comdr. Samuel Freedman, USNR (Ret.), president of AFCEA's new San Diego Chapter.

with the Air Research and Development Command.

Capt. Cunningham cited some of the problems of maintaining efficient communications in the face of obstacles ranging from security measures to salt spray and tropical fungus. His unclassified remarks dealt both with the Nevada and Eniwetok communications programs.

To accompany his remarks, the Captain showed a color film concerning the Nevada tests. The film, "Atomic Tests in Nevada," was obtained from FCDA Hdqs, Battle Creek, Michigan.

Annual elections were held during the business session, with the following result: president—B. R. Robards, Southwestern Bell Tel. Co.; vice presidents—Col. Harold L. Hughes, Chief of Staff, AACS, and Louis E. Dechant, Dechant Electric Co.; treasurer—Kenneth H. Norris, DCS/O, Hdqs. MATS; secretary—Allan L. Eisenmayer, 3310th TT Gp (ATC); directors—Maj. Gen. D. C. Doubleday, Commander, AACS; Lt. Col. Mike M. Kovar, DSC/O, Hdqs. MATS; Harry L. Cooper, AT&T, Long Lines; Harry W. Vermillion, Western Union, and A. Lisle Lenny, Alton & Southern R. R.

South Texas

At an informal meeting with the chapter's administrative body on April 14th, Capt. W. B. Goulett, AFCEA Executive Vice President, reported on AFCEA affairs and conducted a discussion of ways and means of extending national and chapter activities.

The dinner-meeting took place at the Fort Sam Houston commissioned officers' mess with Col. Will D. Joslin, USA, chapter president, acting as host. Among those present were: Col. Albert H. Snider, USAF, and Stephen H. Simpson, Jr., past presidents of the chapter; Maj. Vincent Grzegorowicz, chapter secretary, and various members of the board of directors.

Southern California

A luncheon meeting of officers and directors was held at the Statler Hotel on April 8th. The occasion was the visit of Executive Vice President Goulett who stopped in Los Angeles while enroute to the organizational meeting of the San Diego Chapter. The business session was marked by an open forum on AFCEA matters.

Those in attendance were: Chapter President Lester R. Daniels of Daniels Engineering, Inc.; First Vice President John W. Inwood, district manager, Western Union Telegraph Co., and the following directors: Richard Fuller, vice president, Bendix Aviation Corp.; Lt. Col. Loyd C. Sigmon, vice president, Golden West Broadcasters; L. D. Callahan, sales manager, Gilfillan Brothers, Inc.; John Byrne, vice president, Motorola, Inc.; Richard B. Leng, vice president, Packard Bell Co.; Rear Adm. Charles F. Horne, vice president, Convair; J. H. Goodrich, commercial representative, Pacific Telephone and Telegraph Co.; James McLean, president, Hoffman Laboratories. Special guests were: Adm. Timothy Wellings, USN (Ret.), and Thomas P. Walker, consultant, Litton Industries.

Tinker-Oklahoma City

William H. Forster, Director of Research, Solid-State Electronics Department, Philco Corporation, Philadelphia, was the principal speaker at the April 17th meeting. He discussed "Semi-Conductor Electronics and Their Application to the Infrared Spectrum."

Meeting with the chapter for the first time was AFCEA Executive Vice President W. B. Goulett who reported on association affairs.

The meeting took place at the Tinker Air Force Base Officers Mess.

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ITEMS OF INTEREST

From Government, Industry and the Services

Subliminal Perception

Use of subliminal techniques in motion pictures would enhance dramatic impact by stimulating viewers' sensory reactions, according to representatives of a subliminal projection equipment manufacturer.

Hal G. Becker and Robert E. Corrigan of the Precon Corporation, New Orleans, La., described newest subliminal perception techniques for motion pictures at the semi-annual convention of the Society of Motion Picture and Television Engineers.

They promised that use of "Psychorama," trademark for the motion picture projection system, will never involve advertising or commercial sales messages.

Recent experiments in the application of subliminal perception to motion pictures have disclosed that emotionally charged or taboo words and symbols must appear three times longer on the screen than "neutral" words in order to overcome subsconscious "censorship."

Additionally, it was determined that viewers could be persuaded to like or dislike a particular scene by flashing subliminal symbols which are known to connote pleasure or displeasure.

A feature length motion picture, "My World Dies Screaming," which embodies "Psychorama," will be released theatrically in the near future.

Polaris Launching Equipment

Launching equipment for the U.S. Navy's Polaris missile has undergone its first tests by completing numerous "firings" of dummy missiles.

The trial firings were labeled "Operation Peashooter" and made from the Westinghouse Electric Corportion's experimental test installation at the San Francisco Naval Shipyard. The company designed and developed the equipment.

Some of the mock-up missiles are constructed of redwood, which floats, simplifying their recovery. Underwater tests are under way at other experimental sites.

Polaris, a fleet ballistic missile, is being designed to be launched from above or below the surface of the water. The nation's first ballistic missile to be assigned to specially equipped naval ships, it will be capable of carrying a thermonuclear warhead.

Development work on the launching and handling system for the missile is being conducted at the Westinghouse Sunnyvale manufacturing division in California under a $10,000,000 prime contract awarded to the company last year by the Navy.

The Lockheed missile systems division at Sunnyvale has a prime Navy contract on the Polaris missile itself.

The Polaris missile, with its range of 1500 miles, will have "flexibility and mobility unique to naval operations."

Physiological Data By Radio or Phone

The Naval Medical Research Institute, National Naval Medical Center, Bethesda, Md., has revealed a development which would permit physiological information to be transmitted over long distances by radio or telephone.

Such information as heartbeat, breath sound, spoken words and other measurements of the physical condition of humans or animals can be transmitted from isolated areas to Bethesda.

This is accomplished by utilizing the electrical impulses generated in the body and by converting other measurements such as body temperature and respiratory volume into electrical equivalents. The electrical phenomena are taken from the body by means of suitable electrodes. These and the electrical equivalents of other measurements are amplified as required and caused to modulate an oscillator or a radio transmitter. The impulses are then transmitted over radio or telephone circuits to Bethesda, where the signal is converted back to the original form it had in the subject's body. It is then portrayed on oscilloscopes, direct writers and audio systems. At the same time the data is recorded on magnetic tape to provide a permanent record.

With this system, isolated medical practitioners and small clinics will be able to take advantage of the services of medical specialists available only in large cities.

Also, through this system, it will be possible "to obtain the measurements of the physical condition of future animal and human occupants of space vehicles."

The technique for the transmission of physiological information was developed by Project RAM (Research Astronautical Medicine), under the direction of Captain Norman Lee Barr, Medical Corps, USN. He is Deputy Director of the Research Division of the Bureau of Medicine and Surgery.

Soviet Arm

Russian sources reported recently that their scientific and medical workers are developing an artificial arm controlled from the brain.

Tass, the Soviet news agency, quoted an article from the magazine *Youth Technology*. "The artificial bio-electrical arm will carry out the functions of an arm under the influence of bio-currents passing from the central nervous system through the preserved parts of severed muscles.

"Work is in progress on new models of arms with a sense of touch, which are capable of transmitting sensations of temperature, solidity and the texture of objects grasped."

A research scientist and a doctor who took part in the construction of the prototype artificial arm wrote the story. The process was compared to automatic plane controls which operate an aircraft "by obeying the pilot's thoughts."

According to *Tass*, the desired movements are only thought about and then the arm carries them out.

Mine Detector

Equipped with transistors instead of electron tubes, a seven-pound mine detector has been designed to locate mines with metal components.

Developed by the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Virginia, the device weighs only one fourth as much as the current standard model. Also, it has four times the battery life.

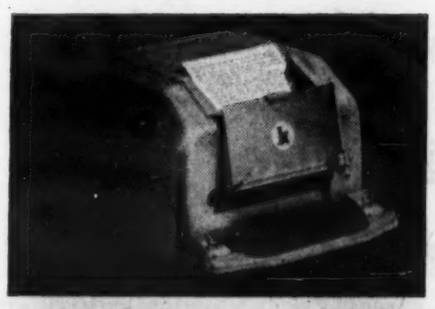
In addition to reducing over-all weight, sensitivity has been increased and stability improved. Maintenance has been simplified to such a degree that operators can perform major repairs.

Major weight reductions have been accomplished in the electronic assembly worn on the operator's standard

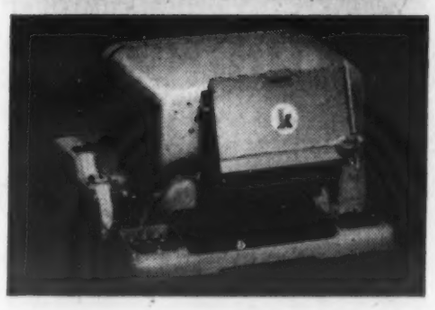
At U. S. Air Force bases of operation, Kleinschmidt page printers and reperforator teletypewriters receive and transmit printed messages at speeds up to 100 words per minute.

Instant and precise communications between Air Force bases is a prime requisite in this era of supersonic speeds. To meet this essential need, Kleinschmidt teletypewriters and related equipment, developed in cooperation with the U. S. Army Signal Corps, provide fast transmission and receipt of printed communications. There is no time-lag for interpretation, no chance of misunderstanding, since both sender and recipient have identical printed originals . . . instantly.

Research and development of equipment for transmitting and receiving printed communications has been a continuing project at Kleinschmidt for almost 60 years. This unparalleled store of experience, now joined with that of Smith-Corona Inc, holds promise of immeasurable new advances in electronic communications.



Model 150 Page Teleprinter
Transmits and receives teleprinted messages at pre-set speeds of 60, 66, 75 or 100 words per minute. Uses roll or fanfold paper. "Semi-rev" operation, whereby shafts rotate only a half-revolution, reduces maintenance, prolongs life of unit.



Model 120 Typing Reperforator—Tape Transmitter
This versatile unit receives and transmits messages in perforated tape form and permits reproduction, editing and preparation of tape, as well as manual keyboard transmission.

KLEINSCHMIDT

KLEINSCHMIDT LABORATORIES, INC., DEERFIELD, ILLINOIS

Pioneer in teleprinted communications equipment • A subsidiary of Smith-Corona Inc.,

military cartridge belt. This 7" x 5" x 1" unit consists of four hermetically sealed plug-in sub-assemblies, each containing several transistors with their associated circuitry. Repairs involve merely replacing one or more of these compact, plug-in units with a spare.

The search head is mounted on a collapsible handle through which wiring connects it with the electronic and head set assembly. A control box attached to the handle contains a combined power-sensitivity switch and an indicating meter.

In operation, metal upsets the search head balance, the electronics assembly amplifying this unbalanced signal for headset and meter indication.

Built by Texas Instruments, Inc., Dallas, Texas, under negotiated contract with the Laboratories, the detector has passed all engineering tests and is now ready for field testing.

Helicopter Altimeter

Recently the United States Navy revealed the first military low-altitude altimeter designed and developed for use in helicopters. Simultaneously, Sylvania Electric Products Inc., designers and producers of the altimeter, announced that it is available for military and commercial use.

Sylvania said that the new altimeter, designated the AN/APN-117, meets military requirements, has been flight tested, and complete sets have been delivered to and are in use by the Navy. The sets were designed to have special capabilities for hovering, important to the Navy in its anti-submarine effort, and for reconnaissance and rescue operations.

The radar set consists of two specially-designed units—an electronic control amplifier and a control-height indicator — and uses a standard receiver - transmitter, housing and mounting base. The system is available as a unit or as a two-piece kit for converting a standard APN-22 to the APN-117.

Applicable to all aircraft including helicopters, drones and missiles where low-altitude information is desired, the radar set is essentially a microwave altimeter designed to measure the surface or terrain clearance of an aircraft from zero to 1000 feet without the necessity of adding protruding external antennas.

According to Sylvania, the device's superior features include a low-altitude expanded scale and improved readability of altitude information at lower altitudes.

The company also pointed out that provisions have been made for completing a tie-in to automatic pilots or other devices requiring selected altitude data, and that a limit indicator system is included in the set to provide an indication of flight below a pre-set altitude. Additionally, a reliability circuit is included which prevents the pilot from using the indicator when the signal is too weak to provide reliable operation.

The altimeter was developed by Sylvania in conjunction with the Navy Bureau of Aeronautics.

Punch Card

A punch card operated steering system for a moon radar antenna has been described by Olaf A. Guzmann of the U. S. Army Signal Corps Engineering Laboratories, Fort Monmouth, N. J. Twenty-five times more accurate than previous electronic systems, it can be applied in modified form for tracking other celestial bodies, including satellites.

Naval Observatory data regarding the orbit of the moon is punched into cards and fed to a digital computer which then calculates where the moon will be at different instants with respect to the antenna. This information is stored on magnetic tapes and fed into an analog conversion system which provides a continuous flow of positional signals that keep the antenna aimed constantly and accurately at the moon as it moves across the sky.

Techniques for bouncing radar signals off the moon, pioneered by the Signal Corps in 1946, have recently taken on added importance in radio communications and radio astronomy. (SIGNAL, Sept. 1957, p. 65) Last year the Naval Research Laboratory succeeded in receiving voice signals that were reflected by the moon, opening up the possibility of using the moon to relay long-distance radio transmissions. More recently the same group used moon radar to measure the distance to the moon with an accuracy of within 1000 feet.

Coded TV

Technicolor Corporation, Burbank, California, recently revealed techniques for improving the efficiency of long-distance television picture transmission. Bandwidth reductions of as much as 4 to 1 were reported.

Existing methods for TV transmission, such as microwave relay systems or coaxial cable, require the equivalent of 1000 telephone circuits for one video channel. Resulting transmissions are said to be expensive and in the case of transatlantic or transpacific communication, lack of adequate

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bandwidth circuits makes television transmission impossible at present.

Most of the area in each television picture contains much less information than the maximum allowed by the channel. This is the fact utilized in the recently revealed system to provide the bandwidth reduction of 4 to 1 or more. To achieve such a reduction, the picture signal is translated into a series of dots and spaces in much the same manner as the dots and dashes of the Morse Code.

In the complete system, a normal television camera output is fed into a small high-speed electronic computer which codes the video signal before transmission to the receiver, where a similar computer translates the code before presenting the picture on a regular television tube. An essential feature of the device is the temporary retention of the coded signal in electrostatic storage tubes to average out the information rate.

Commercial long-distance relaying —especially transoceanic routes— "will probably be the most important application of this new system." It is also said that military applications may be important, since the "beyond the horizon" scatter propagation communication links now under construction generally will be able to handle the coded signal.

"Home Warning" Device

Under contract with the Federal Civil Defense Administration, an inexpensive "home warning" device, called the National Emergency Alarm Repeater (NEAR), has been developed.

A contract providing for the first field test has been signed by Midwest Research Institute of Kansas City, Mo., and the Consumers Power Company of Jackson, Mich.

The device, a small plastic-covered electronic box, can be plugged into any 110-volt electrical outlet. It gives no sound until authorities issue an order to warn of approaching attack or natural disaster. Then, brief, controlled signals, transmitted over the regular power network, trigger the alarm receiver. It buzzes loudly to warn listeners to turn on the radio for official civil defense instructions.

Names in the News

Melvin E. Lowe has been appointed as Manager of the Missile Systems Laboratory of Sylvania Electronics Systems. Mr. Lowe joined Sylvania in 1955, prior to which he was in charge of developing major radar data processing systems for the Tactical Air Command at the Air Force's Cambridge Research Center in Massachusetts.

Fred R. Lack, Vice President of Western Electric Company's Radio Division since 1943, will retire August 31. He will be succeeded by **C. Raymond Smith**. Mr. Lack is associated with many key electronics associations and committees and also worked on design and installation of ship-to-shore telephone systems and on vacuum tube R & D. He is a member of AFCEA's Board of Directors and Executive Committee and is a past president of the Association.

Louis O. Mitchell has been elected Vice President of Trans-Sonics, Inc. He will continue as Production Manager, a position he has held since 1948.

Henri Busignies, President of Federal Telecommunication Laboratories, will direct the new IT&T Laboratories. The laboratories are the result of consolidation of all United States research and development activities of International Telephone and Telegraph Corporation.

William G. Thompson retired last month as Assistant Vice President of the American Telephone and Telegraph Co. A pioneer in many national and international communications developments, he was active in the expansion and development of telephone service between the United States and foreign countries.

John A. Kuypers has been appointed by the Military Division of Lenkurt Electric Company as Manager of Government Sales in the western area. He has been with Lenkurt since 1953.

John J. O'Brien, former President of the Teletype Corp., was recently named a Vice President of the Western Electric Co. The Board of Directors of the Teletype Corp. elected **Maurus T. Goetz** as President to succeed Mr. O'Brien.

Col. Kenneth W. Klise, USAF (Ret.), has joined Page Communications Engineers as a project manager. He recently returned from Subic Bay in the Philippines where he had charge of the installation of U. S. Navy communications and electronic facilities as Assistant Chief Engineer for the Pomeroy-Hawaiian Dredging-Bechtel group.

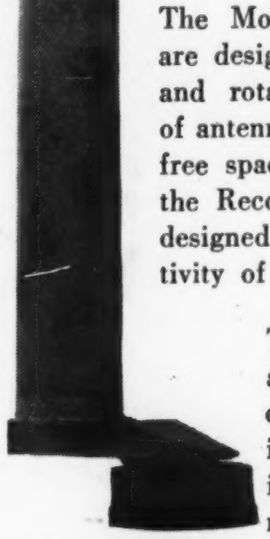
William A. Stevenson will direct the design of the Navy's Polaris ballistic missile which is being developed by Lockheed Missile Systems Division. He will be in charge of structural and internal systems design of the missile itself.

Theodore Berrier, retired Assistant Vice President of the American Telephone & Telegraph Co. in its Washington office, has been elected an honorary member of the White House Correspondents Association.

COMPLETE MODEL RANGE SYSTEMS

Scientific-Atlanta, Inc. offers complete instrumentation for model antenna test ranges.

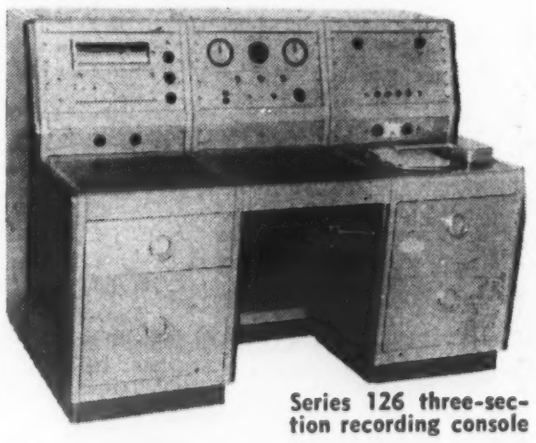
The Model Range Towers are designed for supporting and rotating scale models of antennas under simulated free space conditions while the Recording Consoles are designed to plot the directivity of the antennas.



Model 401 Range Tower With Extension Section

The Model Towers are of all-dielectric construction, reducing radiation field influence to a minimum. Standard towers are available in 8-foot and 16-foot heights and will support 200-pound loads. Other towers are available on special order.

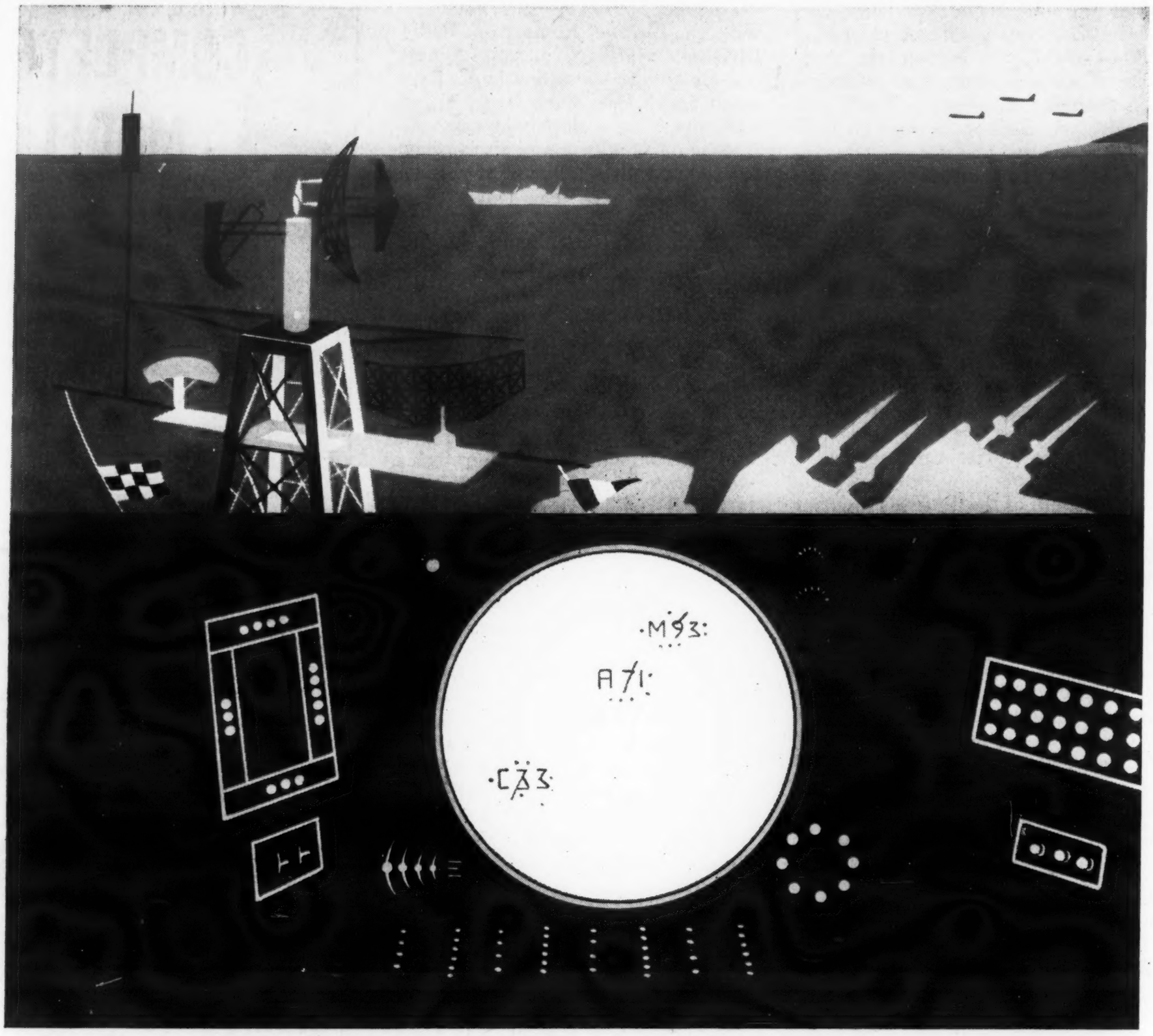
The Recording Consoles provide linear, logarithmic or square-root graphs in either rectangular or polar coordinates. The consoles include a Tower Control and Indicator Unit and may include a Pattern Integrator.



Series 126 three-section recording console

SCIENTIFIC-ATLANTA, INC.

2162 Piedmont Road, N.E.
Atlanta 9, Georgia



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- *Ballistics*
- *Radar Antennas*
- *Guided Missile Support Equipment*
- *Auxiliary Power Supplies*
- *Control Systems*

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NEW PRODUCTS FROM INDUSTRY

4-Track Stereo Tape Recorder

A new magnetic tape recorder with an ability to record and reproduce high-quality stereo music at a speed of 3¾ inches per second on a four-track tape has been scheduled by its developers, Ampex Corporation of Redwood City, Calif., to be commercially available by this summer.

Two sets of 2-track stereo music are put on a ¼-inch tape. One set of 2 stereo tracks plays in one direction. Then, by reversing direction of travel of tape, the second set of 2 tracks is played.

The tape width is .043 inch and the separation between tracks is .025 inch. This standard has been determined by the subcommittee on Magnetic Tape Recording for the Electronics Industry Association.

All Ampex "A" series stereo tape recorders now on the market can be converted by means of a simple modification for reproduction of these new 4-track tapes, while maintaining a capability of reproducing existing 2-track, 7½-inches-per-second tape.

Digital Computer Processes Pictures

Engineers of the National Bureau of Standards have developed scanning and display equipment which will permit a computer to convert pictures, diagrams or other graphical material into digital form suitable for input.

After the information is processed according to a pre-arranged routine, the results are displayed as a visual output.

The advance is cited as indicative of a broad new horizon of application for high-speed electronic computers.

"New" Electrostatic Microphone

A new type microphone featuring extremely light weight (3 ounces) and novel high sensitivity has been developed for TV and motion picture sound pickup.

A product of RCA's David Sarnoff Research Center, Princeton, N. J., the device employs, in a novel manner, electrostatic principles which were used in early broadcast microphones more than 25 years ago but which were too expensive and inconvenient for practicality. With the gradual development of new materials and improved techniques, it was found possible to revert to the earlier principle with strikingly effective results in terms of weight, performance and cost.

Use of the principle permits an elimination of the magnetic materials present in standard microphones.

Unique Tape Strobe

A new stroboscopic device which accurately and quickly checks tape speeds of all standard speed tape recorders and players has been developed by Scott Instrument Labs, 17 E. 48th St., N.Y.

The new Tape Strobe is a precision-mounted wheel, housed in a machined aluminum yoke such that the user may apply it directly to moving tape.

Under 60-cycle light sources, reference marks on the wheel disc appear to stand still if the tape is moving past the capstan at correct speeds (7½ ips, 15 ips and 30 ips). If the tape speed is slightly slow, the wheel disc reference marks will appear to move slowly backward and, conversely, will move forward if the tape speed is too fast.

The device may be used when the supply reel is fully loaded and the take-up reel is empty. Again, it may be used in the opposite situation. If the Tape Strobe indicates the speed is not correct under both extreme conditions, there is a need for adjustment of drag breaks.

Space Thermometer

In response to the continued emphasis on low-temperature research which has highlighted the need for a device to indicate low temperatures accurately without needed recalibration, there is now available a new germanium resistance thermometer, described to have high sensitivity and exceptional stability in the temperature range near absolute zero. Furthermore, when once calibrated, the device is reproducible to better than a few ten thousandths of a degree at the boiling point of helium (4.2°K) even after repeated cycling from room temperature.

The developers, Bell Telephone Labs. of New York, indicate that such characteristics deem this thermometer particularly useful for the accurate measurement of temperatures in outer space when mounted in a suitable space vehicle.

Stereo-Disc Playing Instrument

The gap between stereo and conventional recording has been closer bridged by "industry's first" stereo-disc playing instruments, recently introduced by The Magnavox Co. of Fort Wayne 4, Indiana. Conventional equipment thus need not become obsolete.

The system permits addition of speakers and amplifiers to any of Magnavox's high-fidelity phonographs or radio-phonographs through the use of a small coupling box together with replacement of the old monaural pickup cartridge with a stereophonic cartridge.

The new compatible disc of the CBS Laboratory is used with this conversion system, which will cost about 50% more than present monaural equipment.

High-Speed Data Transmission

A tape communication system which permits high-speed transmission of serialized digital information at 1200 wpm (20:1 compression ratio) and at 3000 wpm (50:1 compression) has been recently announced. Designated the Avcom Compressor-Expander, Model CEM-50-1, the two-unit precision tape-recording communication system is a product of Avco Manufacturing Corp.'s Research and Advanced Development Division, Lawrence, Mass.

Avcom's 1200 wpm transmission is considered a 50% improvement over present systems. The high-speed digital signals described above are recorded and immediately subject to low-speed playout at 60 wpm for direct operation of a standard teleprinter or tape puncher. Transmission of voice, digital, teletype, punch card, or any other data is provided for and, although it is expected to have various potential applications, the system is of particular value where compressed information must be instantly available.

Both units together weigh 250 pounds and measure 48 x 23 x 20 inches, tape bins included.

Communications Receiver

Operating in the frequency ranges of 105 to 155 Mc, a new communications receiver has been designed for commercial airport use by the Nems-

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Claimed to embody features not customarily found in units of this type and designed for standard relay rack mounting with an 8¾-inch-high panel, the instrument employs a double conversion superheterodyne circuit with automatic noise limiter, an automatic volume control, and a squelch circuit.

New Programing Circuit

A simple, inexpensive method of controlling the rate and/or magnitude of change of a variable has been developed by Assembly Products, Inc., of Chesterland, Ohio. The method involves a circuit built around a new type contact meter-relay action and applies to any variable that can be measured electrically.

Accomplishing the same programing effect as a closed loop pulse servomechanism, but much more easily, the control circuit is believed to be the first to apply a feed-back signal directly to a meter-relay as a means of guiding control action. Programing can be set up with cams, punched tape, or any other common method.

Since the circuit is considered a "breakthrough" of a relatively uncomplicated electro-mechanical device into a field hitherto reserved for complex electronic hook-ups, it is expected to lead to widespread use of meter-relays in programed operations simply because the meter-relay performs the dual function of signal comparison and initiation of control action.

World Time Clock

An instrument capable of measuring the exact moment of any event, anywhere on earth, to the nearest thousandth-second, has been developed by Edgerton, Germeshausen & Grier, Inc., of Boston, Mass.

Developed primarily for use in testing nuclear devices, the clock however is expected to have many other useful applications.

MC RF **Filters**

Typical of Microphase Techniques:
Multiplexer (left, below) with crystal video output
–55 dbm Tangential Sensitivity up to 12 kmc/s.
S-Band Waveguide Filter (right, below): high performance;
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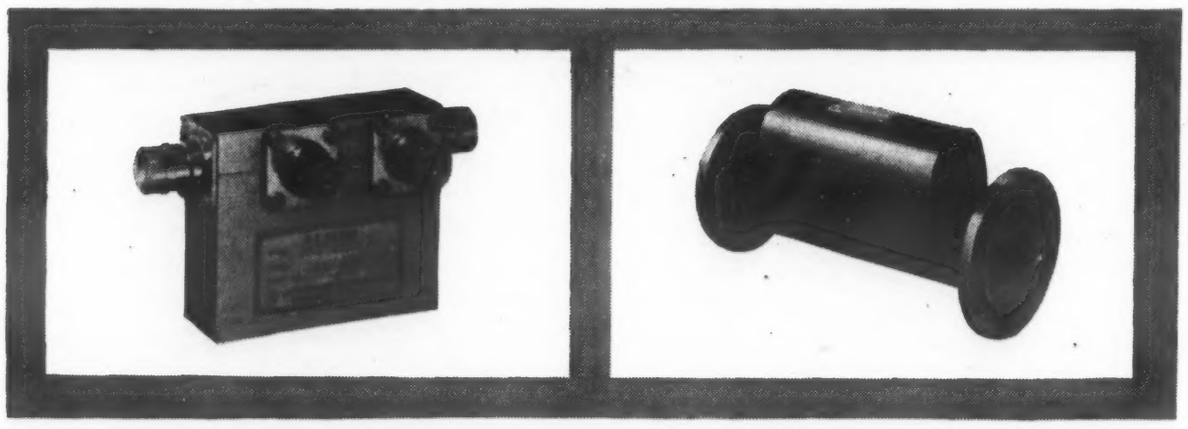

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New Literature

Recording Satellite Signals?

With minor modifications, the radio amateur can adapt his basic equipment to tune in the transmitters in satellites so as to receive and to record information about meteors, cosmic rays, space dust and other phenomena. Such recordings are potentially valuable since official receiving stations are only in contact with each satellite for a small part of its orbit.

Assembled with the aid of the U. S. Naval Research Lab. in Washington and the Jet Propulsion Lab. at the California Institute of Technology, a new booklet provides diagrams and charts and describes methods for adapting basic equipment, recording on magnetic tape, interpreting data received, timing accurately the recordings, and contacting satellite data headquarters to determine the value of material received.

At a 10¢ handling cost, a copy may be obtained from Audio Devices, 444 Madison Ave., New York 22, N. Y.

Price Lists of Research Reports

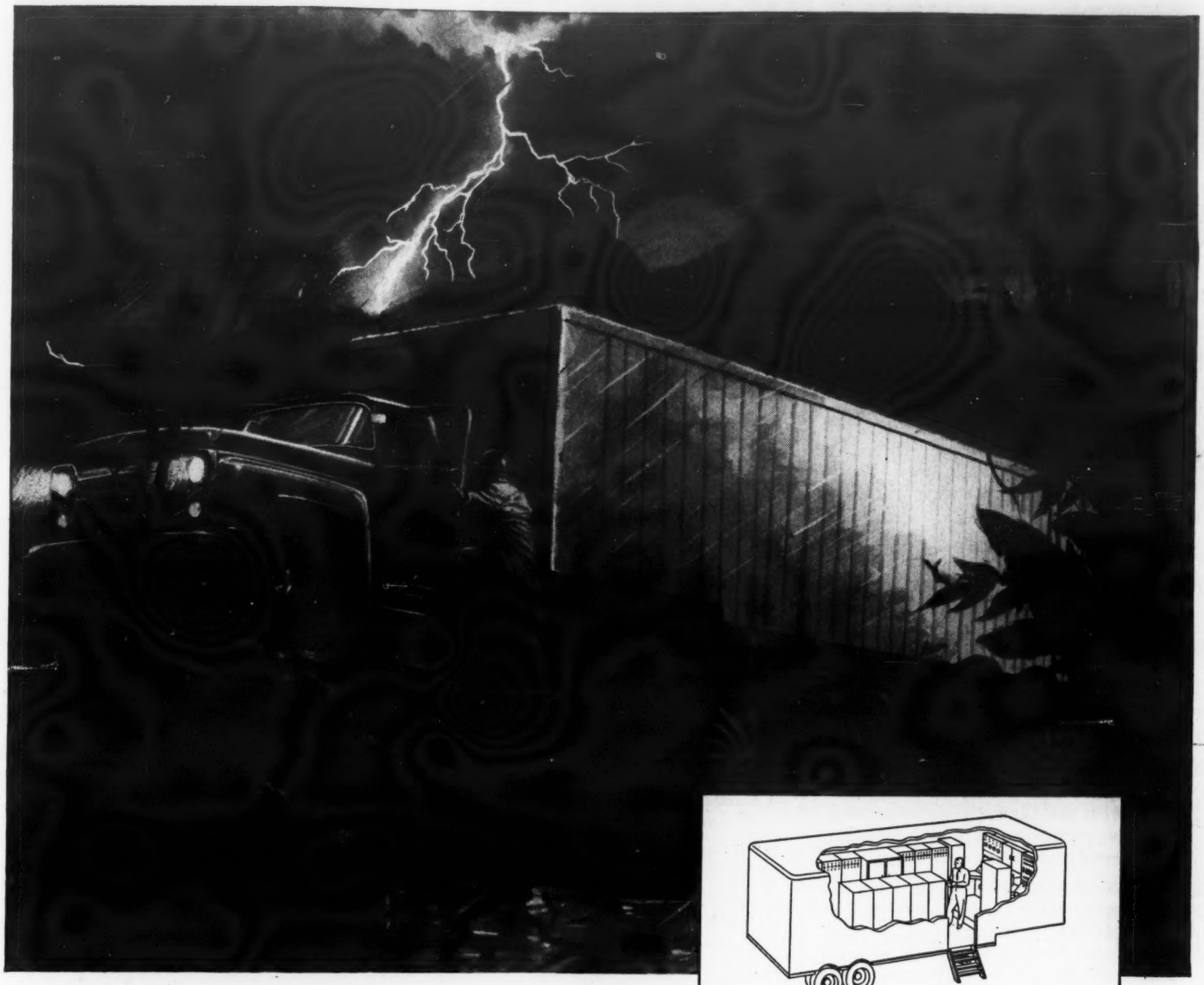
A cumulative listing of more than 4000 Atomic Energy Commission unclassified research reports which includes new documents acquired in the Office of Technical Services' collection since August 1957 is now available at no cost. The lists are issued semi-annually and the next will be available in August 1958. Request AEC Research Reports Price List #29 from OTS, U. S. Dept. of Commerce, Washington 25.

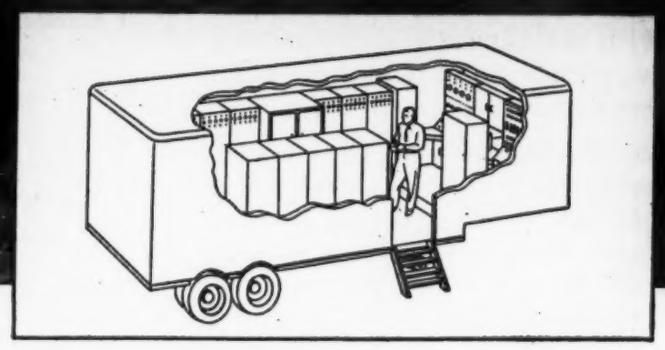
Another publication, *U. S. Government Research Reports*, lists new research reports immediately after release by the AEC and describes reports from the Army, Navy, Air Force and other government agencies which are available through the OTS. Issued monthly, this publication may be obtained on a subscription basis from Supt. of Documents, U. S. Government Printing Office, Washington 25, D. C., at $6.00 a year.

Quality Control Document

The product of four years' preparation, a new DOD quality control standard (MIL-STD-414) embodying a statistical method of sampling inspection by variables has been released to the public.

The 110-page document directly concerns production problems in electronics, missiles, and high-performance aircraft. Entitled "Sampling Procedures and Tables for In-





Rugged and right—a computer on wheels

MOBIDIC'S getting ready to roll anywhere

Today's demands for fast handling of information and split-second decisions have made computers an integral part of many fixed-based operations. BUT why not provide these same advantages to army headquarters *in the field*—where speed is more important than ever before?

This is the problem the U. S. Army Signal Engineering Laboratories and Sylvania are solving together by the development of MOBIDIC—a general purpose mobile digital computer designed to handle the Army's data processing problems in the field and ruggedized to travel over the roughest terrain through the most difficult temperature extremes.

Mounted in a 26-foot trailer, and ready to roll at any time, MOBIDIC will be available wherever decisions are made, to receive and process information from forward and rear locations, to provide up-to-the-second information to administrative and tactical staffs. Hundreds of details such as unit strengths, firepower, supply and vehicle availability, and field intelligence will become readily available to decision-making staff officers through MOBIDIC.

MOBIDIC's list of skills includes processing of logistical and intelligence information as well as analytical and real-time computation.

MOBIDIC is another example of Sylvania's integrated approach to systems engineering and close cooperation with the Armed Services. From concept to production, Sylvania's engineering talents and manufacturing facilities are ready for any challenge. If your project requires this kind of capability, Sylvania engineers will be glad to discuss it with you. For information on the capabilities of Sylvania's Electronic Systems Division, write for free booklet titled, "*A Digest of Specific Capabilities.*"

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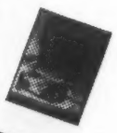

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spection by Variables for Percent Defective," the standard is used with MIL-STD-105, "Sampling Procedures and Tables for Inspection by Attributes."

Both publications are available from the U. S. Government Printing Office, Washington 25, D. C., at the respective costs of 65¢ and 45¢.

New Management Journal

Research Management, a new quarterly publication which will be devoted to discussions of problems in the field of research management, has been undertaken jointly by the Industrial Research Institute, Inc., and Interscience Publishers, Inc., both of New York City.

Since industrial research is a 6-billion dollar activity, its proper organization and management presents problems of common interest to managers in widely diversified fields. Ideas as to proposed solutions of these varied problems will be published in the journal and will be contributed by the research-manager representatives of the member companies of the Institute. Annual subscription price is $7.50.

Standards for Electron Tube Materials

Recommended as a valuable reference tool for the designer and electronics engineer, the first edition of the *Compilation of ASTM Standards for Electron Tube Materials* has been prepared and published by the American Society for Testing Materials in recognition of the importance of electronics to such fields as missiles; satellites; business, scientific calculating and data recovery machines—in addition to the field of communications.

The 242-page volume contains 41 standards relating to cathode materials, insulators, strip materials, wire, metallic and non-metallic seals, and miscellaneous materials.

Copies, at $3.50 each, may be purchased from ASTM Hdqrs., 1916 Race St., Phila. 3, Pa.

Flow-Matic System Booklet

A method of automatically translating, at electronic speed, the flow chart of a systems expert into the language of the Univac II data-automation system is described in a free booklet recently released by the Remington Rand Univac Division, 315 Fourth Avenue, New York 10.

Entitled "Introducing a New Language for Automatic Programing" (U1350), the publication details some of the unique savings to be derived from use of the Flow-Matic System of automatic programing.

Two Russian-English Glossaries

The Russian-English Glossary of Aeronautical and Miscellaneous Terms, a 704-page document containing approximately 30,000 aeronautical and miscellaneous terms, has been prepared by the U. S. Air Force and may now be ordered from OTS, U.S. Dept. of Commerce for $7.00.

Emphasis within the glossary is placed on compound terms which most frequently present difficulty for translators, technicians or scientists in rendering idiomatically accurate interpretations.

The reference volume, *Russian-English Glossary of Acoustics and Ultrasonics*, by P. Robeson, Jr., contains over 10,000 terms in these two fields and offers the English method of writing the names of scientists.

Priced at $10.00, the 193-page book is published by The Consultants Bureau, Inc., of New York.

Infrared Developments Report

"Around The Servo Circuit," a special 16-page report describing the application of infrared to military weapons systems and industrial control systems, can be obtained at no cost from Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, New York.

Detailed text and illustrative material present the striking effectiveness with which infrared instrumentation and systems are providing new solutions to problems of industry. A recently declassified section reveals the role of advanced infrared developments for strategic and tactical situations, including missile guidance, bombing, wide area reconnaissance, anti-submarine warfare and countermeasures.

Astronomy Handbook

Written for the layman and illustrated by 121 photographs and 58 drawings, *Astronomy Handbook*, by Dr. Leon A. Hausman, describes man's present knowledge of the universe, the planets and the stars. At $2.00 a copy, the book is available from the Arco Publishing Co. of New York.

A cut-out star finder slide rule is provided to simplify study of the night skies, enabling the user to locate major stars and constellations easily and at any time.

Extending the study to the do-it-yourself stage, the book gives easy-to-follow instructions for building a 200-power telescope and a quarter-ton tripod.

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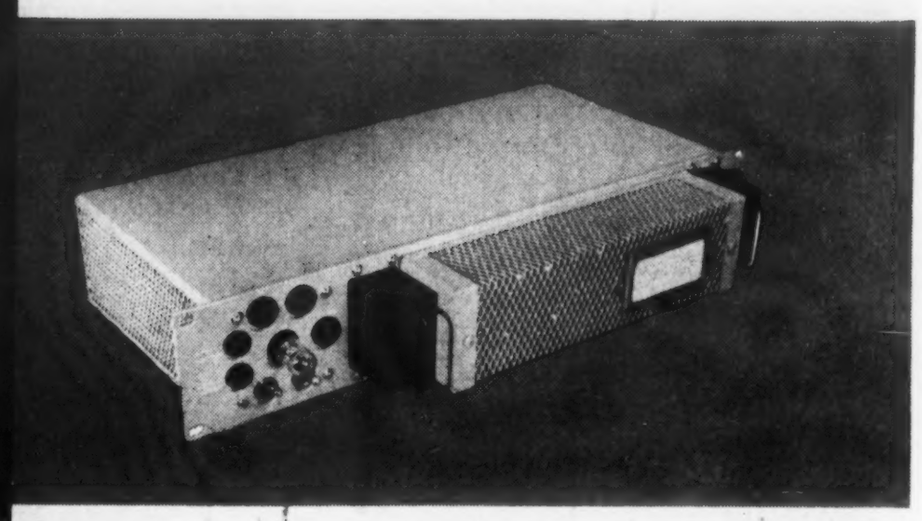
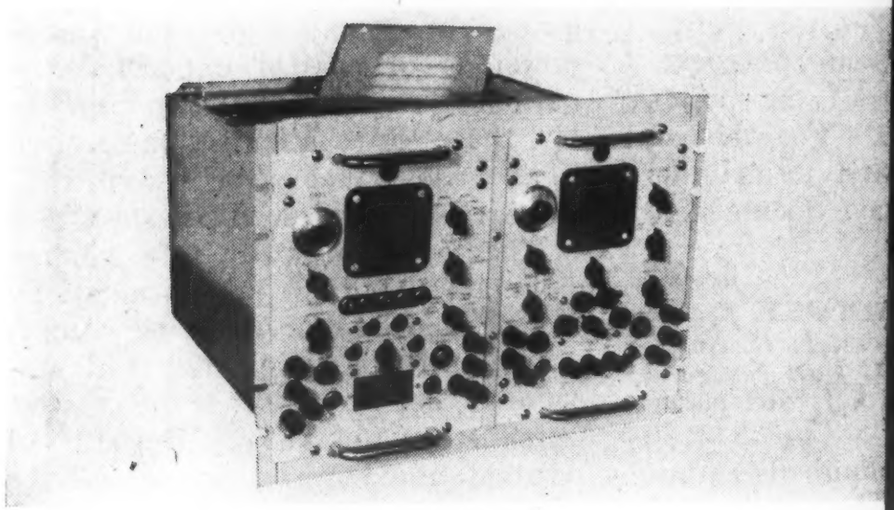


TDMS 5EB and 6EB TELEGRAPH DISTORTION MEASURING SETS

Locates and measures distortion in land-line and radio teleprinter circuits and automatic switching networks. Also measures transmission speeds and may be used to test high-speed telegraph relays.

Bulletin RAD E-100



TRR.2 REGENERATIVE REPEATER

Detects and regenerates teleprinter signals distorted as much as 49%. The regenerated output contains no more than 1% distortion. Also measures and rejects spurious start signals, distinguishes and passes long space signals, and automatically inserts correct-length stop elements.

Bulletin RAD E-102

This equipment was developed in England by Automatic Telephone & Electric Co., Ltd. to meet the requirements of the USAF STRATCOM system and has been successfully used throughout the world. It is manufactured and sold in the United States by Radiation, Inc. under exclusive license from A. T. & E. [Bridgnorth] Ltd.

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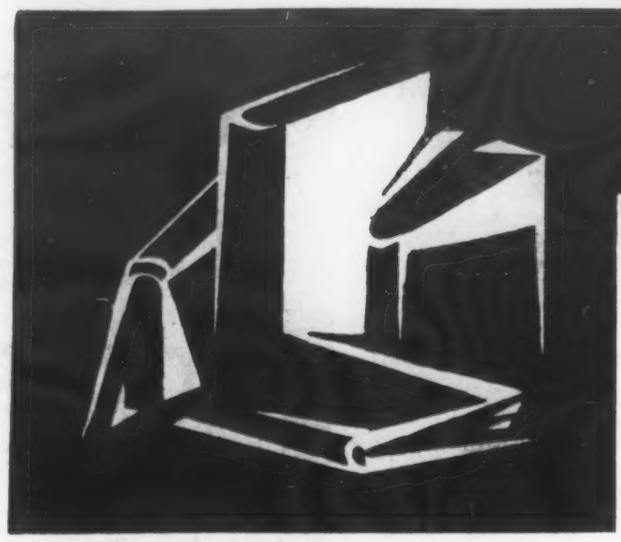

LOGICAL DESIGN OF DIGITAL COMPUTERS, by Montgomery Phister, Jr. John Wiley & Sons, Inc., New York. 408 pages, $10.50.

Introductory in level, Dr. Phister's discussion concentrates on techniques explaining their practical application to the design of digital systems by the logical-equation method.

The presentation centers on synchronous machines, providing interpretation of known advances in this field together with original, unpublished material. A full chapter is given to the development of Boolean algebra while another chapter collects and compares all important Boolean simplifications.

Additional highlights considered original in a book concerned with this topic include the systematic method for complete computer design, complete solutions to flip-flop input equations, a description of the logical properties of memories and input-output devices, the Huffman-Moore model, and the Huffman-Mealy method of computer circuit synthesis.

The Director of Engineering with Thompson-Ramo-Wooldridge Products, Inc., of Los Angeles, Dr. Phister has had considerable experience with the logical design of computers and with circuit design, system design, programing, and maintenance.

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PHOTOGRAPHY AND THE LAW, by George Chernoff and Hershel B. Sarbin. Doubleday & Co., Inc., New York. 127 pages; cloth-bound, $3.50. paper-bound, $1.95.

The legal scene in the field of photography has been given an excellent, comprehensive treatment in this new work by two lawyers who, in addition to their practice in New York, author regular columns for *Popular Photography* Magazine.

The authors discuss the problem of individual legal interpretation so as to include the difficulties in defining such debated subjects as obscenity, libel, and invasion of privacy. Other areas of interest, equally important to the photographer, include questions of obtaining releases for models, of ownership and copyright, of damages to pictures and concerning use of photographs as court evidence. A valuable examination of photography as a business venture describes its sundry dangers and pitfalls.

A further consideration reveals the legal, although controversial, status of photography as being an art rather than a profession, and describes the effect of such definition as it bears upon a court decision.

A lengthy question/answer section of typical queries from photographers sums up most of the points covered in the work. For the inquiring mind interested in original sources, the authors have documented the book.

TRANSISTOR TECHNOLOGY, Vol. I, Ed. by H. E. Bridgers, J. H. Scaff, and J. N. Shive. D. Van Nostrand Co., Inc., Princeton, N.J. 661 pages, $7.50.

In the belief that rapid dissemination of new technical knowledge will further accelerate the growth of transistor technology, a 3-volume work has been compiled by staff members of The Bell Telephone Laboratories which outlines and demonstrates the soundness of the fundamental principles of transistor technology founded by BTL a few years ago.

While Vol. I presents a basic framework, Vols. II and III discuss modern developments in materials, structures and techniques to illustrate further the basic principles.

Vol. I, under consideration here, contains an excellent exposition of the principles of germanium transistor fabrication, with specific information necessary in each step leading to commercial-scale production. Original material prepared by BTL for use by Western Electric Co. and its licensees is included, as revised in light of current practice.

The newest zone-melting processes for purifying germanium metal in commercial quantities are described, including explanation of the method by which single crystals of pure germanium are "seeded" and grown.

In addition, the industrial fabrication methods developed for quick large-scale production of a thoroughly reliable device are outlined in detail, and the means of characterizing the performance of transistors is explored together with the principles of measuring capacity, frequency, noise distortion, and efficiency.

HIGH-TALENT MANPOWER FOR SCIENCE AND INDUSTRY, by J. Douglas Brown and Frederick Harbison. Industrial Relations Section, Princeton University, N. J. 98 pages, $3.00.

The acceleration of change caused by the creative scientist, the research engineer and the outstanding industrial manager has created an enormous appetite for material progress throughout the world; it has gradually made apparent to those of underdeveloped countries that the fostering of such high-talent manpower is of critical importance to national progress. It is, in particular, the creative scientist, the source of new ideas, that is the " 'seed-corn' containing the germ of progress."

The two essays of this volume maintain that high talent cannot be mass-produced but must be discovered, nurtured, motivated and sustained; they propose that the creative scientist is always the initiator of change, and they set out to test the thesis that it is reasonable to suppose his development should respond to similar measures, no matter in what part of the world. Thus, the essays examine, in parallel, the problems faced in America and those arising in the underdeveloped and newly industrialized countries of the world. The appropriate role of the corporation, the university, and the State in the development of high talent is explored in both writings.

New Teletype Composite Set at AFCEA Convention

You are invited

When? June 4 through 6

Where? Teletype Exhibit, Booths 23-24
Sheraton Park Hotel, Washington, D. C.

What? Annual Convention, Armed Forces Communications and Electronics Association

See the Model 28 ASR—Automatic Send-Receive Set—newest of the new line of Teletype equipment. Our engineers will be in attendance to answer any questions you may have.

Versatile, compact. In the Model 28 ASR a single, compact, console houses page printer, tape reader, tape punch and keyboard—plus numerous optional features and accessories—for a wide variety of communications and data processing applications.

Speed, dependability, low maintenance. The ASR incorporates all of the advanced design features of the Model 28 line. Printing, tape punching and tape reading at 100 WPM; off-line tape preparation at higher speeds. Smooth, continuous operation—with exceedingly low maintenance—is assured with lightweight mechanisms, type box printing and all-metal clutches.

If you miss the convention but want more information on the new Model 28 ASR, write to Teletype Corporation, Dept. 71F, 4100 Fullerton Avenue, Chicago 39, Illinois.

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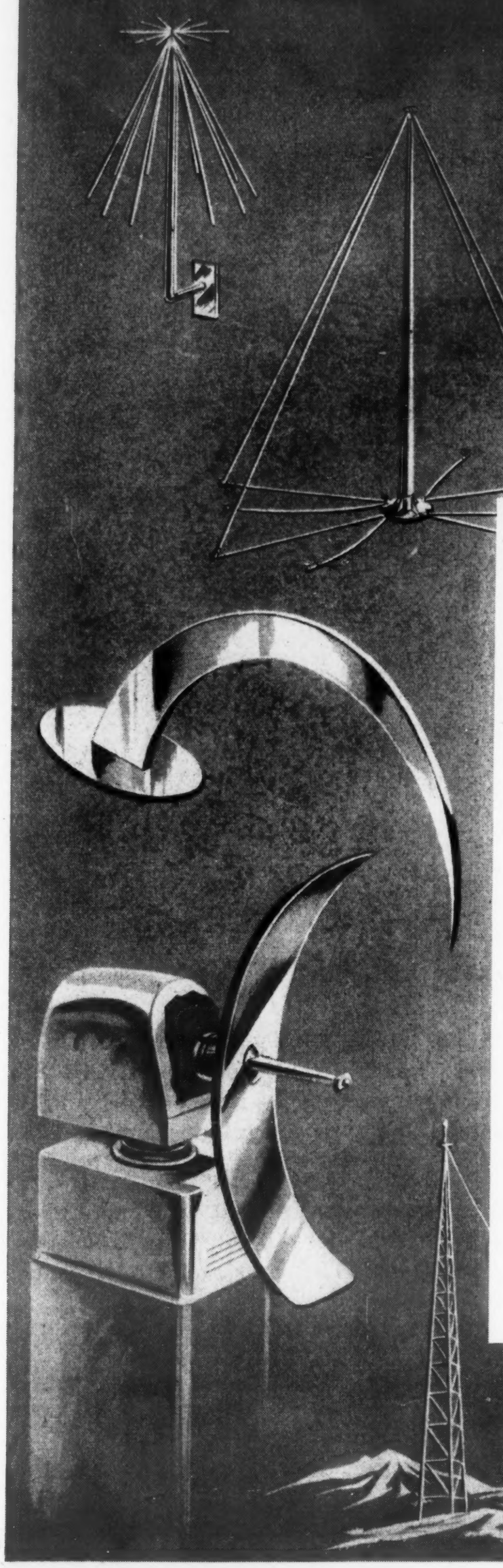
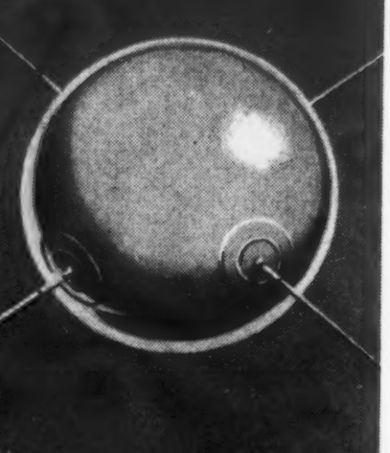
antenna design links up your signal to infinite space





Special engineering competence and exceptional test facilities mark Admiral's Antenna Group

Infinite space is your medium, and the antenna is the gateway through which your signal must enter or exit. Think of the antenna as the all-important terminal stage that makes or mars the effective performance of your brilliantly conceived electronic system. Then assign responsibility for optimum antenna design to Admiral's Antenna Development Group. In conjunction with ARDC, BuAer, the Signal Corps and CAB, members of this group have designed antennas for radio direction finders, radars, microwave relay systems and a variety of special military equipments. Three separate test facilities are available to the group for plotting precise radiation patterns.

Admiral's Antenna Development Section is one of eight engineering groups organized for "task force" attack on research and development problems in the fields of military electronics and nuclear radiation. Send for detailed information.

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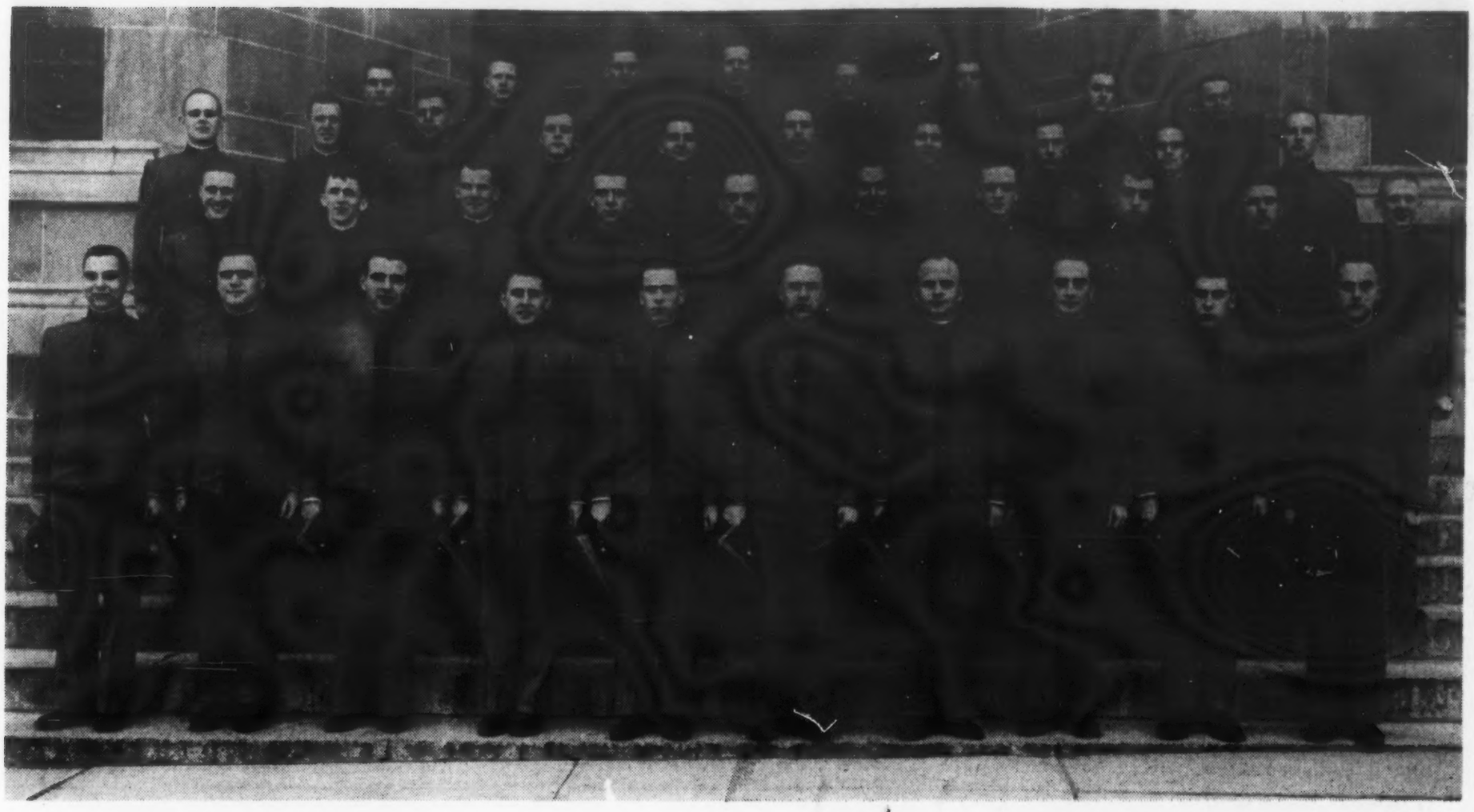
**The activity referred to in this advertisement*



West Pointers Choose Signal Corps

On June 4, 41 members of the graduating class at West Point will join the ranks of the "Arm and Service for Command" the Signal Corps of the Army, thus beginning their commissioned service after having completed their four-year military and academic course at the Academy.

After two months graduation leave, they will be assigned to troop duty with combat Signal units in the United States and various oversea commands, but they will not report until completion of their service schooling including the Basic Officers Course, Ft. Monmouth, New Jersey, and Ranger, Airborne or Army Aviation training.

The Signal Section of the First Regimental Combat Team is responsible for the conduct of all Signal training at the Military Academy. It has the latest equipment so that the cadets can familiarize themselves with the newest material available to combat Signal units in the field. The amount of instruction given is limited due to the large number of other requirements in the curriculum, but is sufficient to give each graduate some basic foundation in communication doctrine and principles.

The Signal Section at the Military Academy is presently directed by Captain Harold C. Friend. It has senior enlisted men assigned to teach all major items of communication equipment needed for the tactics instruction at West Point.

Presently, 14 officers are assigned by the Chief Signal Officer to the Academy in all the phases of cadet life to include instruction in Electrical Engineering, Physics, English, Mathematics, Social Sciences and Military Art and Tactics.

We are certain all military and industrial communicators are happy to welcome this group of new second lieutenants into the "Arm and Service for Command," and extend best wishes for a long and successful career.

Left to Right

★ Front Row

1. Kosmider, G. L.
2. Herberger, K. S.
3. Peters, J. W.
4. Lynne, J. H.
5. Kyle, D. S.
6. Salisbury, A. B.
7. Dus, S. E.
8. Tirre, J. C., Jr.
9. Ackerman, P. W.
10. Wagner, M. P.

★ 2d Row

1. Degen, R.
2. O'Quinn, G. D., Jr.
3. Sedgwick, D. A.
4. Le Mere, C. E.
5. Bauer, A. G.
6. Hardi, A. P.
7. Bottinger, A. G.
8. D'Amore, R. E.
9. Godbey, J. A.
10. Brown, G. A.

★ 3d Row

1. Shunk, P.
2. Jahn, H. R., Jr.
3. Hultzen, R. L.
4. Frick, J. A.
5. Bailey, C. J., 2d
6. Brown, C. O., Jr.
7. Umbaugh, L. D.
8. Willis, J. S., Jr.
9. Wees, G. G.
10. Webb, R. B.

★ Back Row

1. Di Mauro, P. V.
2. Morgan, H. W.
3. Foulkes, W. W., 3d
4. Brintnall, C. M.
5. Cockle, D. S.
6. Gennaro, L. B.
7. Luman, J. C., Jr.
8. Worsham, B. A., Jr.

Not Shown: Shepherd, W. A.; Weis, J. A.; Riordan, M. W., Jr.

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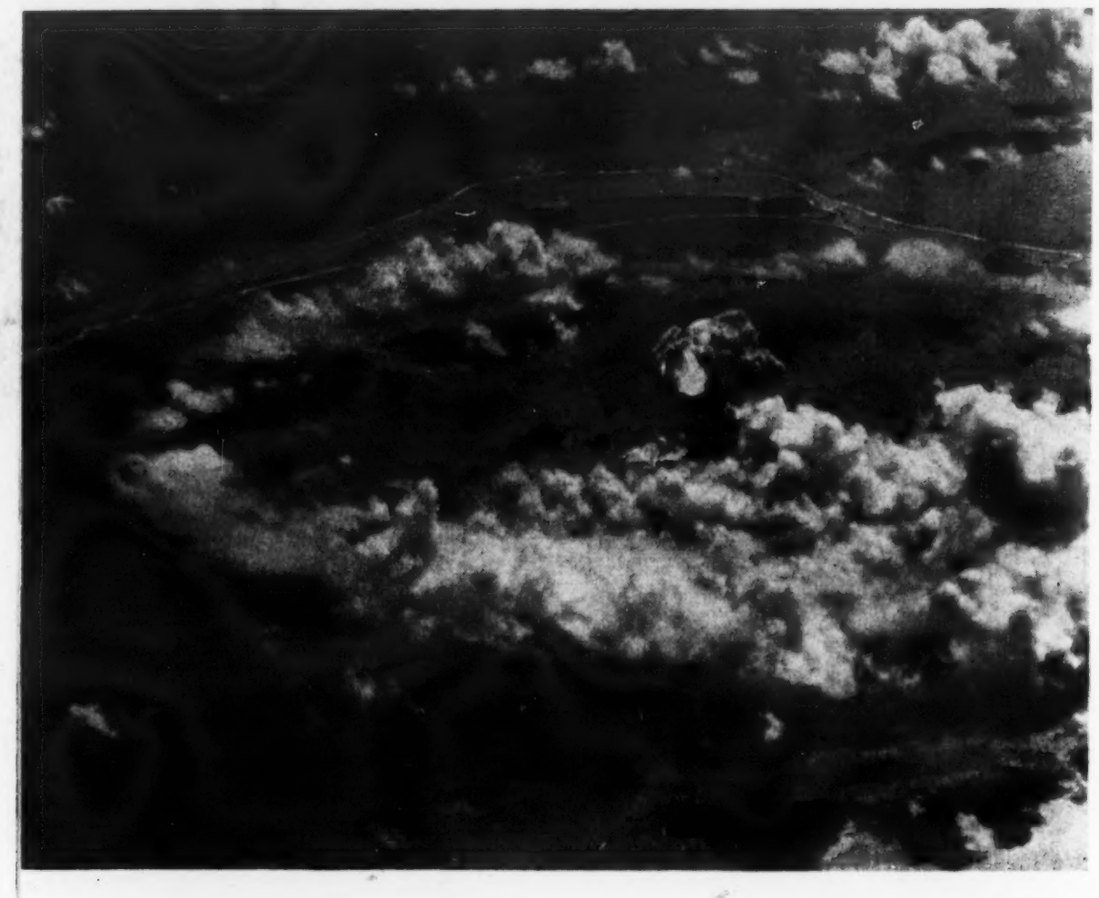

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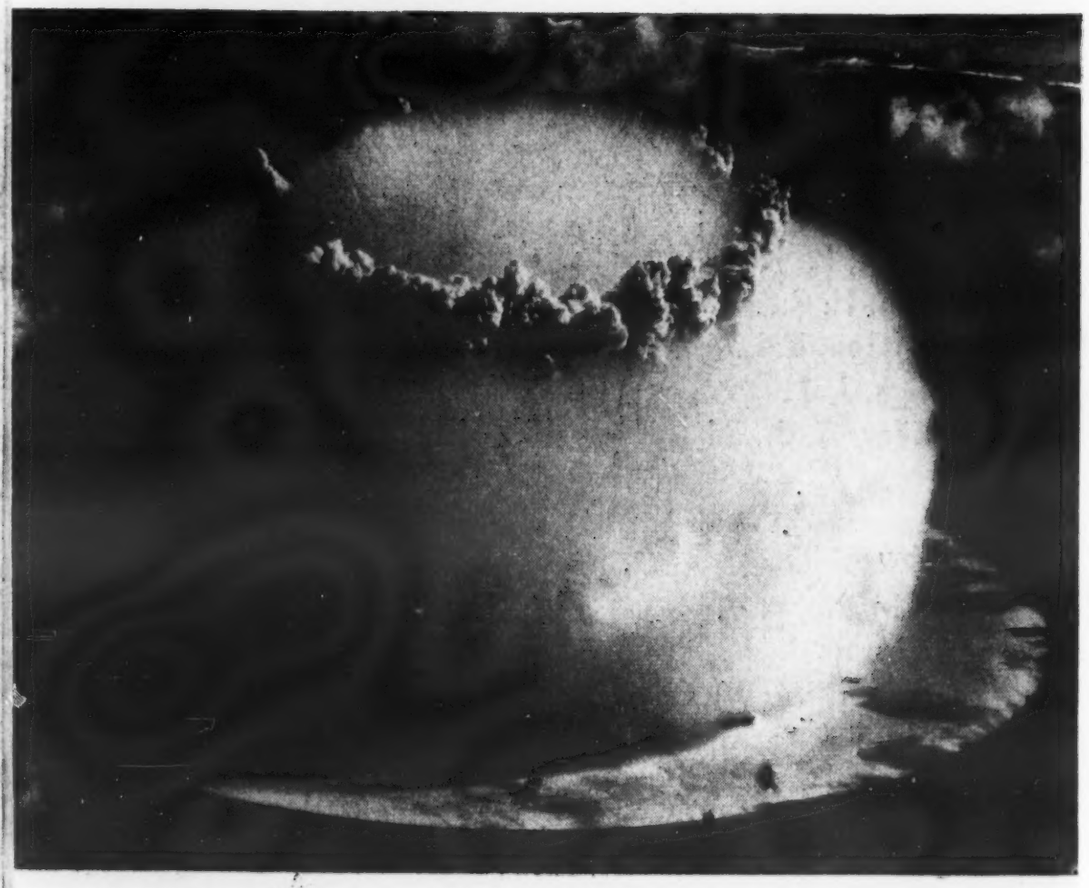

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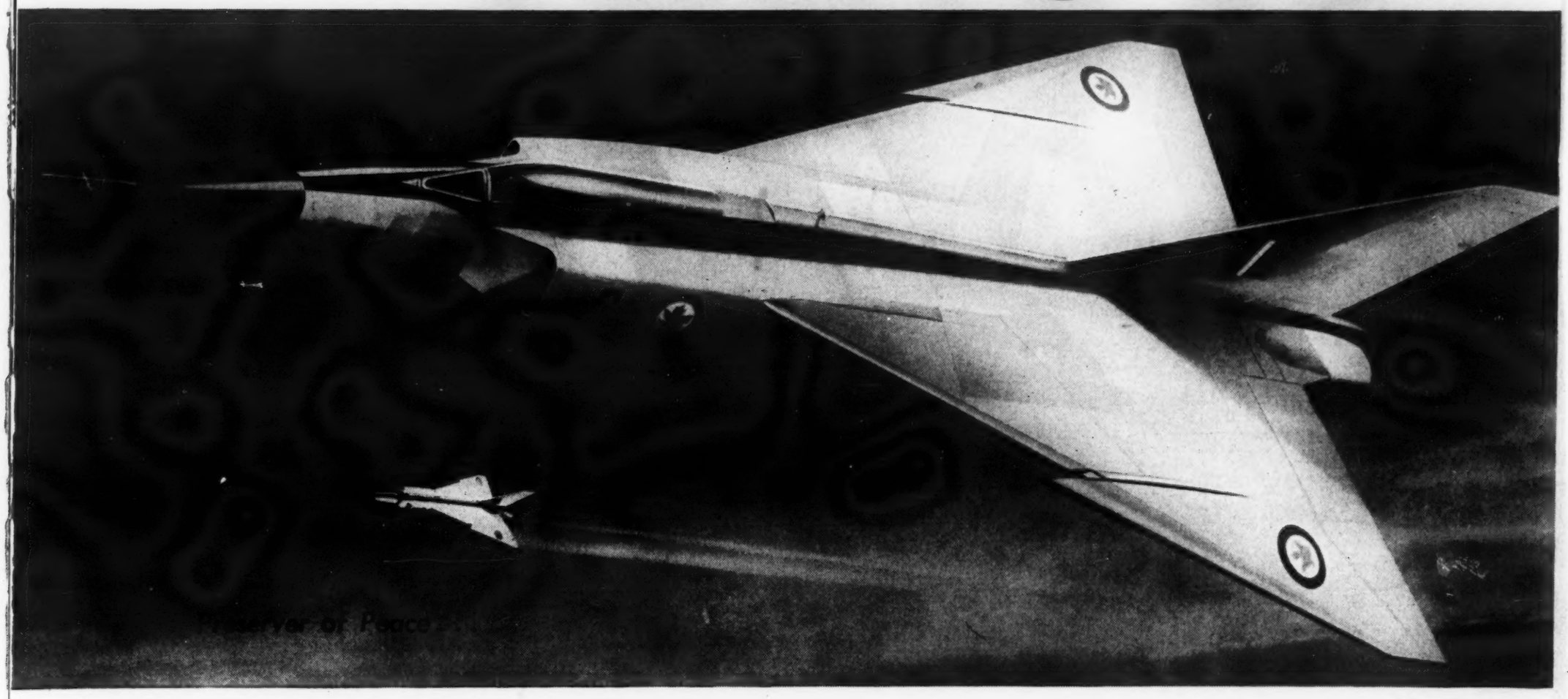

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A Viking Fable

When the terrible green monster suddenly appeared alongside the good ship Viking Queen, all hands save one promptly disappeared over the side into the chill waters of the North Atlantic. Only Lief Smorgasbord, radar operator, remained aboard to face the beast.

If we may take a trembling Lief from history, we will follow the conversation that ensued:

Lief (trembling): Why . . . why didn't you show up on my scope?

Monster (in a high, feminine voice): I'm enchanted, that's why! Oh, Mr. Viking, I'm just a poor princess who has been bewitched and transformed into a teen-age she-sea serpent! If you could answer the

Mysterious R
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or not Tube
("that which

*

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Mysterious Riddle, you could break the spell and marry me!

Lief (still trembling): The Mysterious Riddle?

Monster (hopefully): It goes like this.

Heart of that which has no ears, but hears;
No eyes, but sees; no nose, but knows . . .
Tube B or not Tube B, that is the question!

*Lief managed to answer the riddle, breaking the spell and instantly transforming the monster into a lovely princess. And so they were married and lived happily ever after.**

* *The single word was "Bomac," of course. Lief knew "Tube B or not Tube B" must refer to Bomac tubes, heart of any radar system ("that which has no ears, but hears, etc.") Smart one, that Smorgasbord.*

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